AMENDMENT OF SOLICITATION/	MODIFICATION OF	CONTRACT	1. C	ONTRACT ID COL $N/A$	DE	PAGE OF PAGES 1 63
*	EFFECTIVE DATE OCT 11, 2002	4. REQUISITION/PURCHAS N/A	E RE	Q. NO.	5. PROJECT I	NO. (If applicable) NO. 1278
6. ISSUED BY  DEPARTMENT OF THE ARMY U.S. ARMY ENGINEER DISTRICT, SACRA SACRAMENTO, CALIFORNIA 95814-2922	AMENTO	7. ADMINISTERED BY (If a DEPARTMENT OF U.S. ARMY ENGIN SACRAMENTO, CA	THI EER	E ARMY E DISTRICT,		
8. NAME AND ADDRESS OF CONTRACTOR (No., street, co	ounty, State and ZIP Code)		(√) ×	9B. DATED (SE. N/A	5-02-B-0006 E ITEM 11)	
				10B. DATED (S.	EEE ITEM 13)	
· ·	ACILITY CODE	AMENDMENTS OF SO	ווכ	N/A		
The above numbered solicitation is amended as set for tended.  Offers must acknowledge receipt of this amendment prior	orth in Item 14. The hour a to the hour and date speci copies of the amendmen ides a reference to the soli 8 THE RECEIPT OF OFFERS ment you desire to change	nd date specified for receipt fied in the solicitation or as a t; (b) By acknowledging rec citation and amendment nur S PRIOR TO THE HOUR AND a an offer already submitted	of O amen eipt o nbers DAT such	ffers is extended, by one of the fithis amendment. FAILURE OF YOE SPECIFIED MA't change may be is	e following me t on each copy DUR ACKNOW Y RESULT made by teleg	of the offer LEDG- ram or
12. ACCOUNTING AND APPROPRIATION DATA (If require $N/A$	,	13 BELOW IS N/A.				
		DIFICATIONS OF CON ER NO. AS DESCRIBE			6,	
A. THIS CHANGE ORDER IS ISSUED PURSUANT TO TRACT ORDER NO. IN ITEM 10A.	: (Specify authority) THE $C$ N/ $A$	HANGES SET FORTH IN ITE	M 14	ARE MADE IN T	HE CON-	
B. THE ABOVE NUMBERED CONTRACT/ORDER IS N appropriation date, etc.) SET FORTH IN ITEM 14, P	MODIFIED TO REFLECT TH URSUANT TO THE AUTHO	E ADMINISTRATIVE CHANG DRITY OF FAR 43.103(b).	iES (	such as changes in	paying office,	
C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED I	NTO PURSUANT TO AUTI	HORITY OF:				
D. OTHER (Specify type of modification and authority)	N/A					
E. IMPORTANT: Contractor is not,	is required to sign	this document and re	turn	co	pies to the	issuing office.
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Orga Michael Army Airfield (Phase 1) Dugway Proving Ground, Utah	anized by UCF section heading	gs, including solicitation/contrac	t subj	iect matter where fe	asible.)	
3 Encl						
<ol> <li>Revised Pages: SF 1442 (2 pages), Pricing</li> <li>Revised Drawings: All drawings (Total of 1</li> <li>SF 30 Continuation Page: Clarification No</li> </ol>	16) are Re-Issued, the					tion 16526
Except as provided herein, all terms and conditions of the	document referenced in Ite	m 9A or 10A, as heretofore	chan	ged, remains unc	hanged and in	full force
and effect.  15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF	CON	ITRACTING OFFI	CER (Type or p	print)
15B. CONTRACTOR/OFFEROR  (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF A		RICA		16C. DATE SIGNED

# SF 30 CONTINUATION PAGE

## Clarification Notes:

- 1. This latest amendment covers major design changes to the solicitation. Bid schedules have been prepared for (1) a 6000 foot asphalt runway with two 500 foot concrete turnaround areas and for (2) a 5000 foot runway containing a 75 foot wide keel section including two 1000 foot overruns. Explanation of how the bids will be evaluated is included in the pricing schedules. In addition, there is a mandatory completion date associated with the potential for a variable award date depending upon the availability of funding.
- 2. The select fill and acceptable fill material specifications (2721A) have been modified. Seeding specification (2921A) has been deleted in its entirety. The electrical lighting specification (16526A) has been modified.

Page 1 of 170

SOLICITATION, OFFI	ER,	1. S	OLICITATION NO.	2. TY	PE OF SOLICITATION	3. DATE ISSUED	PAGE OF PAGES
AND AWARD		D . C	CA05-02-B-0006	X	SEALED BID (IFB)	02-Aug-2002	1 OF 170
(Construction, Alteration, or	Repair)	DAC	A03-02-B-0006		NEGOTIATED(RFP)		1 OF 170
IMPORTANT - The "offer" s	section o	n the	reverse must be fully com	plete	d by offeror.	•	
4. CONTRACT NO.			5. REQUISITION/PURCHA W62N6M-2171-	ASE RI	EQUEST NO.	6. PROJECT NO.	
7. ISSUED BY	С	ODE	DACA05		8. ADDRESS OFFER TO	(If Other Than Item 7)	CODE
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS, SACF 1325 J STREET SACRAMENTO CA 95814-2922					UTAH RESIDENT OFFICE 7227 6TH STREET BUILDIN HILL AFB UT 84056-5214	NG 366	
TEL:(916) 557-5238		FAX:	(916) 557-7842		TEL: (801) 777-2206	FAX: (80	1) 777-8699
9. FOR INFORMATION	A. NAM	E			B. TELEPHONE	NO. (Include area code)	(NO COLLECT CALLS)
CALL:	CHERY	L GAI	NNAWAY		916-557-6933		
			S	OLIC	ITATION		
NOTE: In sealed bid sol	icitation	s "of	fer" and "offeror" mea	n "bio	d" and "bidder".		
10. THE GOVERNMENT RE		PERF	FORMANCE OF THE WORI	K DES	CRIBED IN THESE DOC	UMENTS (Title, identifying	no., date):
DUGWAY PROVING GROUS PECIFICATION NO. 1278 DESCRIPTION: At the site of current standards. Project of reinforcement in the portion base in place, build the run Project also consists of complacement. Project includes ESTIMATED COST RANGE Any Contract awarded under Program. See DD Form 17	of the original consists of the new of the n	inal a fremone fremone fremone up of boons up of boon of on of one of other or other fremone f	oval of the asphalt overlay of the the asphalt overlay of the theorem of the concrete and asphalt bate airfield and a Precision App \$\foating\$: \$10,000,000 - \$25,000,000 n will be made pursuant to funrestricted/set-aside information of Alteria and the concrete and asphalt bate airfield and a Precision App \$\foating\$: \$10,000,000 - \$25,000,000 n will be made pursuant to funrestricted/set-aside information of Alteria and the concrete and the conc	of the enstruction a 70 ch plan or oach 00 Public mation	existing 6700-foot airstrip attion has occurred (north el dion has occurred (north el dion-foot runway with <b>toucl</b> nts in the airfield area for p Path Indicator (PAPI) syst Law 100-656, Small Busin	and reuse of the material and). Using the existing ago hdown/turnaround/overn bavement em and all appropriate str	as subgrade gregate gun elements. iping. monstration
				ndator	/, negotiable. (See	FAR 52.211-10	)
12 A. THE CONTRACTOR N (If "YES," indicate within how						DS? 12B. CALENDA	R DAYS
X YES NO							
A. Sealed offers in original a local time OCT 22,2002 shall be marked to show t  B. An offer guarantee X is  C. All offers are subject to th	nd <u>0</u> (date). the offeror	If the state of th	copies to perform the work his is a sealed bid solicitatio me and address, the solicita quired.	on, offe	rs must be publicly opene umber, and the date and ti	d at that time. Sealed end me offers are due.	velopes containing offers
D. Offers providing less than	**	cale	ndar days for Government a	accepta	ance after the date offers	are due will not be conside	ered and will be rejected.

1442-101

Page 2 of 170

			SOLI		ATION, O Construction,			RD			
				( (			or Repair) <b>ly completed</b>	by offeror)			
14. NAME AND ADD	DRESS OF C	OFFEROR	(Include 2	ZIP Co		<u> </u>	• •	nclude area co	ode)		
						16. REMITT	ANCE ADDR	ESS (Include	only if differe	nt than Item	1 14)
CODE	F	ACILITY C	ODE			_					
	vernment in vernments state	writing with od in Item 13	in 3D. Failur CES	ca	llendar days af	ter the date o	ffers are due.	(Insert ar	ny number eq	ual to or gre	
18. The offeror agree	es to furnish	any require	ed perform	nance	and payment b	oonds.					
	(The	e offeror ackr	nowledges r		ACKNOWLED of amendments				och)		
AMENDMENT NO.											
DATE											
20A. NAME AND TI OFFER <i>(Type or pl</i>		RSON AUTI	HORIZED	TO SI	IGN	20B. SIGNA	TURE			20C. OFFEI	R DATE
			Α	WAR	D (To be co	mpleted by	Government)				
21. ITEMS ACCEPT	ED:										
22. AMOUNT		23. ACCOL	JNTING A	ND AF	PPROPRIATIO	ON DATA					
24. SUBMIT INVOIC	ES TO ADD	DRESS SHO	OWN IN			25.	OTHER THAN	FULL AND C	PEN COMP	ETITION PU	IRSUANT TO
(4 copies unless otherw	vise specified)	)				10 l	J.S.C. 2304(c)	)	41 U.S.C.	253(c)	
26. ADMINISTERED	BY	COD	E	<b>'</b>		27. PAY	MENT WILL	BE MADE BY:	CODE		
		CONT	RACTING	OFFI	CER WILL CO	MPLETE ITE	M 28 OR 29 A	AS APPLICAB	LE		
28. NEGOTIATE	D AGREEM	IENT (Conti	ractor is req	uired to	o sign this	29.	AWARD (Co	ntractor is not re	quired to sign t	his document.	)
document and return _ to furnish and deliver a on this form and any co contract. The rights ar governed by (a) this co representations, certific ence in or attached to	all items or per continuation sh and obligations contract award, cations, and s	form all work leets for the o of the parties (b) the solici	x, requisition consideration to this contation, and	ns ident in state tract sh (c) the	tified ed in this nall be clauses,	summate	es the contract, v	ition, is hereby a which consists o ontract award. N	f (a) the Govern	nment solicita	
30A. NAME AND TI TO-SIGN (Type or p	TLE OF CON	NTRACTOF	R OR PER	SON		31A. NA	ME OF CONTRA	ACTING OFFICE	ER (Typ	e or print	=)
30B. SIGNATURE		]:	30C. DAT	 E		TEL:		EMA	AIL:		
			- y <del>- , , ,</del>			31B. UN BY	ITED STATES	S OF AMERIC		31C. A\	WARD DATE

# EXPLANATION OF ALTERNATIVE PRICING SCHEDULES

1. This solicitation includes two alternative construction approaches to this project.

Alternative "A" is for a 6,000 foot asphalt runway with two 500 foot concrete touchdown/turnaround elements. This alternative will be referred to below as the "asphalt" alternative.

Alternative "B" is for a 5,000 foot asphalt runway with a 75 foot wide concrete keel and two 1,000 foot concrete touchdown/turnaround/overrun elements. This alternative will be referred to below as the "concrete keel" alternative.

2. The Government has established two separate pricing schedules for each alternative.

Pricing Schedules 1A (asphalt alternative) and 1B (concrete keel alternative) <u>be used if</u> the contract is awarded on or before Wednesday, January 15, 2003. <u>The bid acceptance</u> period for Schedules 1A and 1B is from the bid opening date through January 15, 2003

Pricing Schedules 2A (asphalt alternative) and 2B (concrete keel alternative) <u>be used if</u> the contract is awarded on or after Thursday, January 16, 2003 and Saturday, March 15, 2003. <u>The bid acceptance period for Schedules 2A and 2B is January 16 through March 15, 2003.</u>

- 3. Bidders may submit prices on one or more of the alternative pricing schedules; i.e., bidders are <u>not</u> required to submit pricing for all of the alternative schedules.
- 4. Bidders must submit prices for all line items on the alternative schedule(s) for which they are submitting a bid.
- 5. Bids for each alternative pricing schedule will be evaluated in accordance with FAR 52.217-5, "Evaluation of options".
- 6. The HUBZone price evaluation preference will be applied in accordance with FAR 52.219-4, "Notice of price evaluation preference for HUBZone small business concerns", to the bids received for each alternative pricing schedule.
- 7. <u>Alternative B (concrete keel alternative) is preferred by the Government, BUT funding availability will dictate which pricing schedule is awarded.</u>

8. The Government reserves the right to make award to the responsive, responsible low bidder on any one of the pricing schedules within the specified bid acceptance periods (i.e., for Alternative Pricing Schedule 1A or 1B, bid opening through January 15, 2003; for Alternative Pricing Schedule 2A or 2B, January 16, 2003 through March 15, 2003), in accordance with the following:

# First bid acceptance period (through January 15, 2003):

If sufficient funds are made available to the contracting officer to award the concrete keel schedule, it will be awarded. If that is not possible, but sufficient funds are available to award the asphalt schedule, the asphalt schedule will be awarded. The government may at some point in time within this period have sufficient funds available for the asphalt schedule, yet continue to seek further funds to award the concrete keel schedule.

# Second bid acceptance period (January 16, 2003 through March 15, 2003):

At no time during the first acceptance period were sufficient funds available to award either schedule. If sufficient funds are made available to the contracting officer during this time period to award the concrete keel schedule, it will be awarded. If that is not possible, but sufficient funds are available to award the asphalt schedule, the asphalt schedule will be awarded. The government may at some point in time within this period have sufficient funds available for the asphalt schedule, yet continue to seek further funds to award the concrete keel schedule.

# ASPHALT ALTERNATIVE PRICING SCHEDULE 1A

(6,000 foot asphalt runway with two 500 foot concrete touchdown/turnaround elements.) (Based on Contract Award by January 15, 2003)

#### BASE SCHEDULE

CONTRACTOR SHALL FURNISH ALL PLANT, LABOR, MATERIAL, EQUIPMENT, ETC. NECESSARY TO PERFORM ALL WORK IN STRICT ACCORDANCE WITH THE TERMS AND CONDITIONS SET FORTH IN THE CONTRACT TO INCLUDE ALL ATTACHMENTS THERETO.

LINE ITEM NO:	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL PRICE
0001	Mobilization and Demobilization.	1	JOB	LS	<i>\$</i>
0002	Demolition of Existing Runway.	1	JOB	LS	\$
0003	Unclassified Excavation	. 36,500*	CY	\$	\$
0004	Select Fill.	34,900*	CY	\$	\$
0005	Acceptable Fill Material.	130,700*	CY	\$	\$
0006	Subgrade Preparation.	88,800*	SY	\$	\$
0007	Subbase Course.	77,800*	CY	\$	\$
0008	Aggregate Base Course.	32,000*	CY	\$	\$
0009	Separation Layer.	124,100*	SY	\$	\$
0010	Drainage Layer.	126,500*	SY	\$	\$
0011	Concrete Pavement.	17,600*	SY	\$	\$
0012	Pre-formed Elastomeric Joints.	16,400*	LF	\$	\$
0013	Bituminous Tack Coat.	1	JOB	LS	\$
0014	Bituminous Prime Coat.	1	JOB	LS	\$
0015	Bituminous Course (2").	8,500*	SY	\$	\$
0016	Bituminous Course (4").	25,000*	SY	\$	\$
0017	Bituminous Course (5").	78,000*	SY	\$	\$
0018	Underdrain System.	1	JOB	LS	\$

Page 7A of 170

0019						
	and Marking.		1	JOB	LS	\$
0020	Runway Lighting					
	including PAPI.		1	JOB	LS	\$
			BASE	PRICE		\$
			-	L OF LIN		
OPTIO	N ITEMS					
0021	Lighting Conduits					
	for Taxiway Conversi	on	1	JOB	LS	\$
0022	Runway Grooving.		1	JOB	LS	\$
0023	Removal of Unsuitable Material	•				
0023A	A Removal of Unsuitab	le				
	Material	First	500*	CY	\$	<i>\$</i>
0023A	B Removal of Unsuitab	le				
	Material.	Next	2500*	CY	\$	<i>\$</i>
			TOTAL	L PRICE	\$	
				AL OF BAS	SE	
				CE PLUS		
				L OPTION		221
			LINE	I ITEMS (	0001 THRU 002	23)

# \* Estimated-Quantity Line Items

The quantities shown above marked by an asterisk are estimated quantities. The estimated quantities are not guaranteed amounts; the contractor will be paid based on actual amounts. The contractor is responsible for tracking actual quantities for each of the estimated-quantity line items. The contractor is responsible to report in writing to the Contracting Officer and the COR immediately when the actual quantities on estimated-quantity line items reach 75% of the estimated quantities. The contractor will present actual quantities and support documentation in evidence of those actual quantities on each invoice for payment against the estimated-quantity line items. The contractor shall not exceed the estimated quantities. Only the Contracting Officer by issuance of an official modification to the contract can change the estimated quantities (increase or decrease); the written, signed modification to the contract must be received by the contractor before the contractor can proceed with work over the existing estimated quantity on the contract. The modification will set the new estimated quantity that the contractor may not exceed without another modification.

<sup>\*</sup> QUANTITY IS AN ESTIMATED AMOUNT. SEE SECTION 00700, FAR 52.211-18, FOR VARIATION IN ESTIMATED QUANTITY CONTRACT CLAUSE.

# CONCRETE KEEL ALTERNATIVE PRICING SCHEDULE 1B

(5,000 foot asphalt runway with a 75 foot wide concrete keel and two 1,000 foot concrete touchdown/turnaround/overrun elements.)

(Based on Contract Award by January 15, 2003)

#### BASE SCHEDULE

CONTRACTOR SHALL FURNISH ALL PLANT, LABOR, MATERIAL, EQUIPMENT, ETC. NECESSARY TO PERFORM ALL WORK IN STRICT ACCORDANCE WITH THE TERMS AND CONDITIONS SET FORTH IN THE CONTRACT TO INCLUDE ALL ATTACHMENTS THERETO.

LINE ITEM NO:	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL PRICE
0001	Mobilization and Demobilization.	1	JOB	LS	\$
0002	Demolition of Existing Runway.	1	JOB	LS	\$
0003	Unclassified Excavation.	14,300*	CY	\$	\$
0004	Select Fill.	30,700*	CY	\$	\$
0005	Acceptable Fill Material.	124,900*	CY	\$	\$
0006	Subgrade Preparation.	88,800*	SY	\$	\$
0007	Subbase Course.	55,600*	CY	\$	\$
0008	Aggregate Base Course.	18,400*	CY	\$	\$
0009	Separation Layer.	124,100*	SY	\$	\$
0010	Drainage Layer.	126,500*	SY	\$	\$
0011	Concrete Pavement.	66,000*	SY	\$	\$
0012	Pre-formed Elastomeric Joints.	54,300*	LF	\$	\$
0013	Bituminous Tack Coat.	1	JOB	LS	\$
0014	Bituminous Prime Coat.	1	JOB	LS	\$
0015	Bituminous Course (2").	8,500*	SY	\$	\$
0016	Bituminous Course (4").	25,000*	SY	\$	\$
0017	Bituminous Course (5").	29,600*	SY	\$	\$
0018	Underdrain System.	1	JOB	LS	\$

Page 7C of 170

0019	Runway Striping and Marking.		1	JOB	LS	\$			
	and Marking.		1	ООВ	ЦЭ	4			
0020			-						
	including PAPI.		1	JOB	LS	\$			
				PRICE L OF LINE II	TEMS	\$			
			0001	THRU 0020)					
<u>OPTIOI</u>	N ITEMS								
0021	Lighting Conduits								
	for Taxiway Conversion	on	1	JOB	LS	\$			
0022	Runway Grooving.		1	JOB	LS	\$			
0023	Removal of Unsuitable Material	e							
0023A	A Removal of Unsuitable	le							
	Material	First	500*	CY	\$	\$			
0023AE	Removal of Unsuitab	le							
	Material.	Next	2500*	CY	\$	\$			
			TOTAL	PRICE	\$				
				AL OF BASE					
				CE PLUS	va				
			ALL OPTION ITEMS LINE ITEMS 0001 THRU 0023)						
			LINE	TIEMS COOT	IHKU UUZ	<i>3 )</i>			

# \* Estimated-Quantity Line Items

The quantities shown above marked by an asterisk are estimated quantities. The estimated quantities are not guaranteed amounts; the contractor will be paid based on actual amounts. The contractor is responsible for tracking actual quantities for each of the estimated-quantity line items. The contractor is responsible to report in writing to the Contracting Officer and the COR immediately when the actual quantities on estimated-quantity line items reach 75% of the estimated quantities. The contractor will present actual quantities and support documentation in evidence of those actual quantities on each invoice for payment against the estimated-quantity line items. The contractor shall not exceed the estimated quantities. Only the Contracting Officer by issuance of an official modification to the contract can change the estimated quantities (increase or decrease); the written, signed modification to the contract must be received by the contractor before the contractor can proceed with work over the existing estimated quantity on the contract. The modification will set the new estimated quantity that the contractor may not exceed without another modification.

<sup>\*</sup> QUANTITY IS AN ESTIMATED AMOUNT. SEE SECTION 00700, FAR 52.211-18, FOR VARIATION IN ESTIMATED QUANTITY CONTRACT CLAUSE.

# ASPHALT ALTERNATIVE PRICING SCHEDULE 2A

(6,000 foot asphalt runway with two 500 foot concrete touchdown/turnaround elements.)
(Based on Contract Award January 16, 2003 through March 15, 2003)

## BASE SCHEDULE

CONTRACTOR SHALL FURNISH ALL PLANT, LABOR, MATERIAL, EQUIPMENT, ETC. NECESSARY TO PERFORM ALL WORK IN STRICT ACCORDANCE WITH THE TERMS AND CONDITIONS SET FORTH IN THE CONTRACT TO INCLUDE ALL ATTACHMENTS THERETO.

LINE ITEM NO:	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL PRICE
0001	Mobilization and Demobilization.	1	JOB	LS	\$
0002	Demolition of Existing Runway.	1	JOB	LS	\$
0003	Unclassified Excavation.	36,500*	CY	\$	\$
0004	Select Fill.	34,900*	CY	\$	\$
0005	Acceptable Fill Material.	130,900*	CY	\$	\$
0006	Subgrade Preparation.	88,800*	SY	\$	\$
0007	Subbase Course.	77,800*	CY	\$	\$
0008	Aggregate Base Course.	32,000*	CY	\$	\$
0009	Separation Layer.	124,100*	SY	\$	\$
0010	Drainage Layer.	126,500*	SY	\$	\$
0011	Concrete Pavement.	17,600*	SY	\$	\$
0012	Pre-formed Elastomeric Joints.	16,400*	LF	\$	\$
0013	Bituminous Tack Coat.	1	JOB	LS	\$
0014	Bituminous Prime Coat.	1	JOB	LS	\$
0015	Bituminous Course (2").	8,500*	SY	\$	\$
0016	Bituminous Course (4").	25,000*	SY	\$	\$
0017	Bituminous Course (5").	78,000*	SY	\$	\$
0018	Underdrain System.	1	JOB	LS	\$

Page 7E of 170

0019	Runway Striping					_
	and Marking.		1	JOB	LS	\$
0020	Runway Lighting					
	including PAPI.		1	JOB	LS	\$
			(TOTA	PRICE L OF LINE THRU 0020		\$
<u>OPTION</u>	N ITEMS					
0021	Lighting Conduits					
	for Taxiway Conversion	on	1	JOB	LS	\$
0022	Runway Grooving.		1	JOB	LS	\$
0023	Removal of Unsuitable Material	e				
0023A	A Removal of Unsuitable	le				
	Material	First	500*	CY	\$	<i>\$</i>
0023AE	Removal of Unsuitable	le				
	Material.	Next	2500*	CY	\$	<i>\$</i>
			_	PRICE	\$	
			•	AL OF BASE		
				CE PLUS		
				OPTION IT		
			LINE	ITEMS 000	1 THRU 002	23)

## \* Estimated-Quantity Line Items

The quantities shown above marked by an asterisk are estimated quantities. The estimated quantities are not guaranteed amounts; the contractor will be paid based on actual amounts. The contractor is responsible for tracking actual quantities for each of the estimated-quantity line items. The contractor is responsible to report in writing to the Contracting Officer and the COR immediately when the actual quantities on estimated-quantity line items reach 75% of the estimated quantities. The contractor will present actual quantities and support documentation in evidence of those actual quantities on each invoice for payment against the estimated-quantity line items. The contractor shall not exceed the estimated quantities. Only the Contracting Officer by issuance of an official modification to the contract can change the estimated quantities (increase or decrease); the written, signed modification to the contract must be received by the contractor before the contractor can proceed with work over the existing estimated quantity on the contract. The modification will set the new estimated quantity that the contractor may not exceed without another modification.

<sup>\*</sup> QUANTITY IS AN ESTIMATED AMOUNT. SEE SECTION 00700, FAR 52.211-18, FOR VARIATION IN ESTIMATED QUANTITY CONTRACT CLAUSE.

# CONCRETE KEEL ALTERNATIVE PRICING SCHEDULE 2B

(5,000 foot asphalt runway with a 75 foot wide concrete keel and two 1,000 foot concrete touchdown/turnaround/overrun elements.)

(Based on Contract Award between January 16, 2003 through

March 15, 2003)

#### BASE SCHEDULE

CONTRACTOR SHALL FURNISH ALL PLANT, LABOR, MATERIAL, EQUIPMENT, ETC. NECESSARY TO PERFORM ALL WORK IN STRICT ACCORDANCE WITH THE TERMS AND CONDITIONS SET FORTH IN THE CONTRACT TO INCLUDE ALL ATTACHMENTS THERETO.

LINE ITEM NO:	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL PRICE
0001	Mobilization and Demobilization.	1	JOB	LS	\$
0002	Demolition of Existing Runway.	1	JOB	LS	\$
0003	Unclassified Excavation.	14,300*	CY	\$	\$
0004	Select Fill.	30,700*	CY	\$	\$
0005	Acceptable Fill Material.	124,900*	CY	\$	\$
0006	Subgrade Preparation.	88,800*	SY	\$	\$
0007	Subbase Course.	55,600*	CY	\$	\$
0008	Aggregate Base Course.	18,400*	CY	\$	\$
0009	Separation Layer.	124,100*	SY	\$	\$
0010	Drainage Layer.	126,500*	SY	\$	\$
0011	Concrete Pavement.	66,000*	SY	\$	\$
0012	Pre-formed Elastomeric Joints.	54,300*	LF	\$	\$
0013	Bituminous Tack Coat.	1	JOB	LS	\$
0014	Bituminous Prime Coat.	1	JOB	LS	\$
0015	Bituminous Course (2").	8,500*	SY	\$	\$
0016	Bituminous Course (4").	25,000*	SY	\$	\$
0017	Bituminous Course (5").	29,600*	SY	\$	\$
0018	Underdrain System.	1	JOB	LS	\$

Page 7G of 170

0019	Runway Striping and Marking.		1	JOB	LS	\$			
	and Marking.		1	ООВ	ЦЭ	4			
0020			-						
	including PAPI.		1	JOB	LS	\$			
				PRICE L OF LINE II	TEMS	\$			
			0001	THRU 0020)					
<u>OPTIOI</u>	N ITEMS								
0021	Lighting Conduits								
	for Taxiway Conversion	on	1	JOB	LS	\$			
0022	Runway Grooving.		1	JOB	LS	\$			
0023	Removal of Unsuitable Material	e							
0023A	A Removal of Unsuitable	le							
	Material	First	500*	CY	\$	\$			
0023AE	Removal of Unsuitab	le							
	Material.	Next	2500*	CY	\$	\$			
			TOTAL	PRICE	\$				
				AL OF BASE					
				CE PLUS	va				
			ALL OPTION ITEMS LINE ITEMS 0001 THRU 0023)						
			LINE	TIEMS COOT	IHKU UUZ	<i>3 )</i>			

# \* Estimated-Quantity Line Items

The quantities shown above marked by an asterisk are estimated quantities. The estimated quantities are not guaranteed amounts; the contractor will be paid based on actual amounts. The contractor is responsible for tracking actual quantities for each of the estimated-quantity line items. The contractor is responsible to report in writing to the Contracting Officer and the COR immediately when the actual quantities on estimated-quantity line items reach 75% of the estimated quantities. The contractor will present actual quantities and support documentation in evidence of those actual quantities on each invoice for payment against the estimated-quantity line items. The contractor shall not exceed the estimated quantities. Only the Contracting Officer by issuance of an official modification to the contract can change the estimated quantities (increase or decrease); the written, signed modification to the contract must be received by the contractor before the contractor can proceed with work over the existing estimated quantity on the contract. The modification will set the new estimated quantity that the contractor may not exceed without another modification.

<sup>\*</sup> QUANTITY IS AN ESTIMATED AMOUNT. SEE SECTION 00700, FAR 52.211-18, FOR VARIATION IN ESTIMATED QUANTITY CONTRACT CLAUSE.

Page 7H of 170

- 1. Prices must be submitted on all individual items of this Pricing Schedule. Failure to do so may be cause for rejection of bids.
- 2. If a modification to a price based on unit price is submitted which provides for a lump sum adjustment to the total estimated price, the applications of the lump sum adjustment to each unit price in the Pricing Schedule must be stated. If it is not stated, the bidder/offeror agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the Pricing Schedule.
- 3. The bidder/offeror shall distribute his indirect costs (overhead, profit, bond, etc.) over all the items in the Pricing Schedule. The Government will review all submitted Pricing Schedules for any unbalancing of the items. Any submitted Pricing Schedule determined to be unbalanced may be considered nonresponsive and cause the bidder to be ineligible for award.
- 4. The successful bidder/offeror grants the options listed in the Pricing Schedule to the Government. This option may be exercised any time up to 60 days after receipt of Notice to Proceed. Exercise of the option occurs upon mailing of written notice to the Contractor. Exercise will be made by the Contracting Officer. The price for exercise of the option includes all work and effort associated with the scope of that item. For determination of lowest bid, see paragraph titled EVALUATION OF OPTIONS in Section 00100 of this solicitation. No additional time for contract completion will be allowed when an option is exercised. The given contract completion time was formulated to include time necessary to perform all option work.
- 5. EFARS 52.214-5000 ARITHMETIC DISCREPANCIES (MAR 1995)
- (a) For the purpose of initial evaluation of bids/offers, the following will be utilized in resolving arithmetic discrepancies found on the face of the Pricing Schedule as submitted by bidders/offerors:
  - (1) Obviously misplaced decimal points will be corrected;
- (2) Discrepancy between unit price and extended price, the unit price will govern;
  - (3) Apparent errors in extension of unit prices will be corrected;
- (4) Apparent errors in addition of lump-sum and extended prices will be corrected.
- (b) For the purpose of bid/offer evaluation, the Government will proceed on the assumption that the bidder/offeror intends the bid/offer to be evaluated on basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid/offer will be so reflected on the abstract of bids/offers.
- (c) These correction procedures shall not be used to resolve any ambiguity concerning which bid/offer is low.
- 6. Measurement and Payment, for Mobilization/Demobilization shall include all costs associated with: Quarry Development, Concrete Batch Plant, Asphalt Batch Plant, Site Surveying, and Trailer Set-up (including utility connections).

7. EFARS 52.212-5001 VARIATIONS IN ESTIMATED QUANTITIES - SUBDIVIDED ITEMS (MAR 1995)

This variation in estimated quantities clause is applicable only to Items Nos. shown with an asterisk.

- a. Variation from the estimated quantity in the actual work performed under any second or subsequent sub-item or elimination of all work under such a second or subsequent sub-item will not be the basis for an adjustment in contract unit price.
- b. Where the actual quantity of work performed for Items Nos. shown with an asterisk is less than 85% of the quantity of the first sub-item listed under such item, the contractor will be paid at the contract unit price for that sub-item for the actual quantity of work performed and, in addition, an equitable adjustment shall be made in accordance with the clause FAR 52.211-18, Variation in Estimated Quantities.
- c. If the quantity of work performed under Items Nos. shown with an asterisk exceeds 115% or is less than 85% of the total estimated quantity of the sub-items under that item, and/or if the quantity of work performed under the second sub-item or any subsequent sub-item under Item Nos. shown with an asterisk exceeds 115% or is less than 85% of the estimated quantity of any such sub-item, and if such variation causes an increase or a decrease in the time required for performance of this contract, the contract completion time will be adjusted in accordance with the clause FAR 52.212-18, Variation in Estimated Quantities.

Contracting Officer, in writing, before entering into a subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs). The notice must include the following:

- (1) The name of the subcontractor.
- (2) The Contractor's knowledge of the reasons for the subcontractor being on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.
- (3) The compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.
- (4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(End of clause)

52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984)

The Contractor shall be required to (a) commence work under this contract within 05 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than November 15, 2003. 400 calendar days after receipt on notice to proceed. The time stated for completion shall include final cleanup of the premises.

(End of clause)

- 52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000)
- (a) If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of \$1885.00.
- (b) If the Government terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause.

(End of clause)

52.211-15 DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (SEP 1990)

This is a rated order certified for national defense use, and the Contractor shall follow all the requirements of the Defense Priorities and Allocations System regulation (15 CFR 700).

(End of clause)

DACA 05-02-B-0006 Page 158 of 170

- (6) "Supplies" means all property, except land and interests in land, that is clearly identifiable for eventual use by or owned by the DoD at the time of transportation by sea.
- (i) An item is clearly identifiable for eventual use by the DoD if, for example, the contract documentation contains a reference to a DoD contract number or a military destination.
- (ii) "Supplies" includes (but is not limited to) public works; buildings and facilities; ships; floating equipment and vessels of every character, type, and description, with parts, subassemblies, accessories, and equipment; machine tools; material; equipment; stores of all kinds; end items; construction materials; and components of the foregoing.
- (7) "U.S.-flag vessel" means a vessel of the United States or belonging to the United States, including any vessel registered or having national status under the laws of the United States.
- (b)(1) The Contractor shall use U.S.-flag vessels when transporting any supplies by sea under this contract.
- (2) A subcontractor transporting supplies by sea under this contract shall use U.S.-flaq vessels if--
- (i) This contract is a construction contract; or
- (ii) The supplies being transported are--
- (A) Noncommercial items; or
- (B) Commercial items that--
- (1) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it contracts for f.o.b. destination shipment);
- (2) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or
- (3) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.
- (c) The Contractor and its subcontractors may request that the Contracting Officer authorize shipment in foreign-flag vessels, or designate available U.S.-flag vessels, if the Contractor or a subcontractor believes that --
- (1) U.S.-flag vessels are not available for timely shipment;
- (2) The freight charges are inordinately excessive or unreasonable; or
- (3) Freight charges are higher than charges to private persons for transportation of like goods.
- (d) The Contractor must submit any request for use of other than U.S.-flag vessels in writing to the Contracting Officer at least 45 days prior to the sailing date necessary to meet its delivery schedules. The Contracting Officer will process requests submitted after such date(s) as expeditiously as possible, but the Contracting Officer's failure to grant approvals to meet the shipper's sailing date will not of itself constitute a compensable delay under this or any other clause of this contract. Requests shall contain at a minimum --
- (1) Type, weight, and cube of cargo;

- (2) Required shipping date;
- (3) Special handling and discharge requirements;
- (4) Loading and discharge points;
- (5) Name of shipper and consignee;
- (6) Prime contract number; and
- (7) A documented description of efforts made to secure U.S.-flag vessels, including points of contact (with names and telephone numbers) with at least two U.S.-flag carriers contacted. Copies of telephone notes, telegraphic and facsimile message or letters will be sufficient for this purpose.
- (e) The Contractor shall, within 30 days after each shipment covered by this clause, provide the Contracting Officer and the Maritime Administration, Office of Cargo Preference, U.S. Department of Transportation, 400 Seventh Street SW., Washington, DC 20590, one copy of the rated on board vessel operating carrier's ocean bill of lading, which shall contain the following information:
- (1) Prime contract number;
- (2) Name of vessel;
- (3) Vessel flag of registry;
- (4) Date of loading;
- (5) Port of loading;
- (6) Port of final discharge;
- (7) Description of commodity;
- (8) Gross weight in pounds and cubic feet if available;
- (9) Total ocean freight in U.S. dollars; and
- (10) Name of the steamship company.
- (f) The Contractor shall provide with its final invoice under this contract a representation that to the best of its knowledge and belief--
- (1) No ocean transportation was used in the performance of this contract;
- (2) Ocean transportation was used and only U.S.-flag vessels were used for all ocean shipments under the contract;
- (3) Ocean transportation was used, and the Contractor had the written consent of the Contracting Officer for all non-U.S.-flag ocean transportation; or

(4) Ocean transportation was used and some or all of the shipments were made on non-U.S.-flag vessels without the written consent of the Contracting Officer. The Contractor shall describe these shipments in the following format:

QUANTI	CONTRACT		ITEM
	ITEMS	LINE	DESCRIPTION
_			

- (g) If the final invoice does not include the required representation, the Government will reject and return it to the Contractor as an improper invoice for the purposes of the Prompt Payment clause of this contract. In the event there has been unauthorized use of non-U.S.-flag vessels in the performance of this contract, the Contracting Officer is entitled to equitably adjust the contract, based on the unauthorized use.
- (h) In the award of subcontracts for the types of supplies described in paragraph (b)(2) of this clause, the Contractor shall flow down the requirements of this clause as follows:
- (1) The Contractor shall insert the substance of this clause, including this paragraph (h), in subcontracts that exceed the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.
- (2) The Contractor shall insert the substance of paragraphs (a) through (e) of this clause, and this paragraph (h), in subcontracts that are at or below the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.

(End of clause)

- 252.247-7024 NOTIFICATION OF TRANSPORTATION OF SUPPLIES BY SEA (MAR 2000)
- (a) The Contractor has indicated by the response to the solicitation provision, Representation of Extent of Transportation by Sea, that it did not anticipate transporting by sea any supplies. If, however, after the award of this contract, the Contractor learns that supplies, as defined in the Transportation of Supplies by Sea clause of this contract, will be transported by sea, the Contractor --
- (1) Shall notify the Contracting Officer of that fact; and
- (2) Hereby agrees to comply with all the terms and conditions of the Transportation of Supplies by Sea clause of this contract.
- (b) The Contractor shall include this clause; including this paragraph (b), revised as necessary to reflect the relationship of the contracting parties—
- (1) In all subcontracts under this contract, if this contract is a construction contract; or
- (2) If this contract is not a construction contract, in all subcontracts under this contract that are for--

- (i) Noncommercial items; or
- (ii) Commercial items that--
- (A) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it subcontracts for f.o.b. destination shipment);
- (B) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or
- (C) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

(End of clause)

## 52.211-18 VARIATION IN ESTIMATED QUANTITY (APR 1984)

If the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent above or below the estimated quantity, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above 115 percent or below 85 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contractor may request, in writing, an extension of time, to be received by the Contracting Officer within 10 days from the beginning of the delay, or within such further period as may be granted by the Contracting Officer before the date of final settlement of the contract. Upon the receipt of a written request for an extension, the Contracting Officer shall ascertain the facts and make an adjustment for extending the completion date as, in the judgement of the Contracting Officer, is justified.

# 52.219-16 LIQUIDATED DAMAGES-SUBCONTRACTING PLAN (JAN 1999)

- (a) Failure to make a good faith effort to comply with the subcontracting plan, as used in this clause, means a willful or intentional failure to perform in accordance with the requirements of the subcontracting plan approved under the clause in this contract entitled "Small Business Subcontracting Plan," or willful or intentional action to frustrate the plan.
- (b) Performance shall be measured by applying the percentage goals to the total actual subcontracting dollars or, if a commercial plan is involved, to the pro rata share of actual subcontracting dollars attributable to Government contracts covered by the commercial plan. If, at contract completion or, in the case of a commercial plan, at the close of the fiscal year for which the plan is applicable, the Contractor has failed to meet its subcontracting goals and the Contracting Officer decides in accordance with paragraph (c) of this clause that the Contractor failed to make a good faith effort to comply with its subcontracting plan, established in accordance with the clause in this contract entitled "Small Business Subcontracting Plan," the Contractor shall pay the Government liquidated damages in an amount stated. The amount of probable damages attributable to the Contractor's failure to comply shall be an amount equal to the actual dollar amount by which the Contractor failed to achieve each subcontract goal.
- (c) Before the Contracting Officer makes a final decision that the Contractor has failed to make such good faith effort, the Contracting Officer shall give the Contractor written notice specifying the failure and permitting the Contractor to demonstrate what good faith efforts have been made and to discuss the matter. Failure to respond to the notice may be taken as an admission that no valid explanation exists. If, after consideration of all the pertinent data, the Contracting Officer finds that the Contractor failed to make a good faith effort to comply with the subcontracting plan, the Contracting Officer

shall issue a final decision to that effect and require that the Contractor pay the Government liquidated damages as provided in paragraph (b) of this clause.

- (d) With respect to commercial plans, the Contracting Officer who approved the plan will perform the functions of the Contracting Officer under this clause on behalf of all agencies with contracts covered by the commercial plan.
- (e) The Contractor shall have the right of appeal, under the clause in this contract entitled Disputes, from any final decision of the Contracting Officer.
- (f) Liquidated damages shall be in addition to any other remedies that the Government may have.

(End of clause)

- 52.236-16 QUANTITY SURVEYS (APR 1984) ALTERNATE I (APR 1984)
- (a) Quantity surveys shall be conducted, and the data derived from these surveys shall be used in computing the quantities of work performed and the actual construction completed and in place.
- (b) The Contractor shall conduct the original and final surveys and surveys for any periods for which progress payments are requested. All these surveys shall be conducted under the direction of a representative of the Contracting Officer, unless the Contracting Officer waives this requirement in a specific instance. The Government shall make such computations as are necessary to determine the quantities of work performed or finally in place. The Contractor shall make the computations based on the surveys for any periods for which progress payments are requested.
- (c) Promptly upon completing a survey, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The

Contractor shall retain copies of all such material furnished to the Contracting Officer.

(End of clause)

#### 52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994)

- (a) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.
- (b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.
- (c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--
- (1) The Contractor's failure to conform to contract requirements; or
- (2) Any defect of equipment, material, workmanship, or design furnished.

- (d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.
- (e) The Contracting Officer shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.
- (f) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.
- (g) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--
- (1) Obtain all warranties that would be given in normal commercial practice;
- (2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and
- (3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.
- (h) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.
- (i) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.
- (j) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

(End of clause)

252.236-7008 CONTRACT PRICES - BIDDING SCHEDULES. (DEC 1991)

- (a) The Government's payment for the items listed in the Bidding Schedule shall constitute full compensation to the Contractor for --
- (1) Furnishing all plant, labor, equipment, appliances, and materials; and
- (2) Performing all operations required to complete the work in conformity with the drawings and specifications.
- (b) The Contractor shall include in the prices for the items listed in the Bidding Schedule all costs for work in the specifications, whether or not specifically listed in the Bidding Schedule.

#### 252.236-7004 PAYMENT FOR MOBILIZATION AND DEMOBILIZATION (DEC 1991)

- (a) The Government will pay all costs for the mobilization and demobilization of all of the Contractor's plant and equipment at the contract lump sum price for this item.
- (1) 60 percent of the lump sum price upon completion of the contractor's mobilization at the work site.
- (2) The remaining 40 percent upon completion of demobilization.
- (b) The Contracting Officer may require the Contractor to furnish cost data to justify this portion of the bid if the Contracting Officer believes that the percentages in paragraphs (a) (1) and (2) of this clause do not bear a reasonable relation to the cost of the work in this contract.
- (1) Failure to justify such price to the satisfaction of the Contracting Officer will result in payment, as determined by the Contracting Officer, of --
- (i) Actual mobilization costs at completion of mobilization;
- (ii) Actual demobilization costs at completion of demobilization; and
- (iii) The remainder of this item in the final payment under this contract.
- $\hbox{(2) The Contracting Officer's determination of the actual costs in paragraph}\\$
- (b)(1) of this clause is not subject to appeal.

	T	T		IDEX	T	OF DRAWI		T		US of i Soc
SEQ. NO. 1 OF 116		COVER	TITLE TITLE SHEET	SEQ. NO. SHEET NO. 51 OF 116 C-300		TITLE CROSS SECTIONS 1	SEQ. NO. SHEET NO. 94 OF 116 E-001		TITLE  LEGEND AND ABBREVIATIONS	
2 OF 116		G-002INDX	SHEET INDEX	52 OF 116 C-301	C-300-XS	CROSS SECTIONS 2	95 OF 116 F_nn2	E-002GNN	ELECTRICAL GENERAL NOTES	
3 OF 116	G-003	G-003LCTN	PROJECT LOCATION MAP	53 DF 116 C-302	C-302-XS	CROSS SECTIONS 3	198 OF 116 Ic 4nn	E-100LOP	ELECTRICAL LAYOUT PLAN 1	
4 OF 116 5 OF 116	G=004	G-0045L G-005GPL	SHEET LAYOUT GENERAL PROJECT LAYOUT	54 OF 116 C-303 55 OF 116 C-304	C-303-XS	CROSS SECTIONS 4 CROSS SECTIONS 5	97 OF 116 E-101 98 OF 116 E-102	E-101LOP	ELECTRICAL LAYOUT PLAN 2 ELECTRICAL LAYOUT PLAN 3	
6 OF 116	G-006	G-006CPH	CONSTRUCTION SAFETY AND PHASING PLAN	56 OF 116 C-305	C-305-XS	CROSS SECTIONS 6	99 OF 116 E-103	E-103L0P	ELECTRICAL LAYOUT PLAN 4	
7 OF 116	G-007	G-007ABL	ABBREVIATIONS, LEGEND & GENERAL CONSTRUCTION NOTES	57 OF 116 C-306 58 OF 116 C-307	C-306-XS	CROSS SECTIONS 7 CROSS SECTIONS 8	100 OF 116 E-104	E-104LOP	ELECTRICAL LAYOUT PLAN 5 ELECTRICAL LAYOUT PLAN 6	
				59 OF 116 C-308	C-308-XS	CROSS SECTIONS 9	102 OF 116 E-106	E-105LOP	ELECTRICAL LAYOUT PLAN 7	
				60 OF 116 C-309	C_309_YS	CROSS SECTIONS 10				
8 OF 116 9 OF 116			EXISTING CONDITIONS PLAN 1 EXISTING CONDITIONS PLAN 2	61 OF 116 C-310 62 OF 116 C-311	C-310-XS	CROSS SECTIONS 11 CROSS SECTIONS 12				
10 OF 116			EXISTING CONDITIONS PLAN 3	63 UF 116 D-312	C-312-XS	CROSS SECTIONS 13	103 OF 116 E-501	E-501DTL	ELECTRICAL DETAILS 1	
11 OF 116	G-103	C-103-XP	EXISTING CONDITIONS PLAN 4	64 OF 116   C-300A	C-300A-XS	CROSS SECTIONS 1	104 OF 116 E-502 105 OF 116 E-503	E-5020TL	ELECTRICAL DETAILS 2 ELECTRICAL DETAILS 3	
12 OF 116	G-104 G-105	C-104-XP	EXISTING CONDITIONS PLAN 5 EXISTING CONDITIONS PLAN 6	65 OF 116 C-301A 66 OF 116 C-302A	C-301A-XS	CROSS SECTIONS 2	106 OF 116 E-504	E-504DTL	ELECTRICAL DETAILS 4	
				67 OF 116 C-303A	C-303A-XS	CROSS SECTIONS 4	107 OF 116 E-505	E-5050TL	ELECTRICAL DETAILS 5	
<b>—</b>	_	_		68 OF 116 C-304A 69 OF 116 C-305A	C-304A-XS	CROSS SECTIONS 5	108 OF 116 E-506	E-507DT	ELECTRICAL DETAILS 6 ELECTRICAL DETAILS 7	III
14 OF 116	6 C-110	C-110-DP	DEMOLITION PLAN 1	70 OF 116 C-306A	C-306A-XS	CROSS SECTIONS 7	3 2		***************************************	
15 OF 116	6 C-111	C-111-DP	DEMOLITION PLAN 2	71 OF 116 C-307A	C-307A-XS	CROSS SECTIONS 8				
16 OF 116	G-112 G-113	C-113-DP	DEMOLITION PLAN 3 DEMOLITION PLAN 4	72 OF 116 C-308A 73 OF 116 C-309A	C-309A-XS	CROSS SECTIONS 10	110 OF 116 E-601	E-601DIA	WIRING DIAGRAM	<u> </u>
17 OF 116	C-114	C-114-DP	DEMOLITION PLAN 5	74 OF 116 C-310A 75 OF 116 C-311A	C-31DA-XS	CROSS SECTIONS 11	111 OF 118 E-602	E-602DIA	WIRING DIAGRAM	
19 OF 116	G-115	C-115-DP	DEMOLITION PLAN 6	75 OF 116 C-311A 76 OF 116 C-312A	C-311A-XS	CROSS SECTIONS 12	112 OF 116 E-603	E-603SCH	SIGN AND MARKER SCHEDULE	III
				70 OF 110 C=312A	0-312A-A5	0.0000 0.00000 10				
no or	0_100	C_120 AF2	CECNETRY AND DAVING BLAN 1				113 OF 116 E-701	E 704117	VAULT LAYOUT	
20 OF 116	3   C-121	C-121-GE0	GEOMETRY AND PAVING PLAN 1 GEOMETRY AND PAVING PLAN 2 GEOMETRY AND PAVING PLAN 3	77 OF 116 C-500	C-500-BT C-501-BT	TYPICAL RUNWAY SECTIONS 1	114 OF 116 E-702		RISER DIAGRAM	
22 OF 116	C-122	C-122-GEO	GEOMETRY AND PAVING PLAN 3 GEOMETRY AND PAVING PLAN 4	78 OF 116 C-501	C-501-DT	TYPICAL RUNWAY SECTIONS 2 TYPICAL RUNWAY SECTIONS 3	115 OF 116 E=703		EQUIPMENT ELEVATIONS	
23 OF 116 24 OF 116	C-123	C=123=GE0		80 OF 116 C-500A	C-502-DT C-500A-DT	TYPICAL RUNWAY SECTIONS 1				
	C-125	C-125-GEO	GEOMETRY AND PAVING PLAN 5 GEOMETRY AND PAVING PLAN 6	80 OF 116 C-500A B1 OF 116 C-501A 82 OF 116 C-502A	C-501A-DT	TYPICAL RUNWAY SECTIONS 2				g
26 OF 116	C-120A	C-120A-GEO	CECMETRY AND DAVING DIAM 2	82 OF 116 C-502A	C-502A-DT	TYPICAL RUNWAY SECTIONS 3	116 OF 116 E-801	E-801CTL	CONTROL WIRING DIAGRAM	11 Oct 2
28 OF 116	C-122A	C-122A-GE0	GEOMETRY AND PAVING PLAN 3 GEOMETRY AND PAVING PLAN 3							8=
29 OF 116	C-123A	C-123A-GEO	GEOMETRY AND PAVING PLAN 4	83 OF 116 C-504	C-504-DT	PAVEMENT DETAILS 1				
30 OF 116	G-124A	C-124A-GED	GEOMETRY AND PAVING PLAN 5 GEOMETRY AND PAVING PLAN 6	84 OF 116 C-505	C-505-DT	PAVEMENT DETAILS 1				
01 01 110										ا جَا ا
										Pesiped 7
32 OF 116	C-130	C-130-GP	GRADING AND DRAINAGE PLAN 1 GRADING AND DRAINAGE PLAN 2	85 OF 116 C-510 86 OF 116 C-511	C-510-DT C-511-DT	UNDERDRAIN & DRAINAGE DETAILS STORMWATER POLLUTION PREVENTION DETAILS				2 ±
33 OF 116	6 C-131 6 C-132	C-131-GP	GRADING AND DRAINAGE PLAN 2 GRADING AND DRAINAGE PLAN 3	86 UF 116 C-311	C-311-UI	STORMWATER POLLUTION PREVENTION DETAILS				
35 OF 116	3 C-133		GRADING AND DRAINAGE PLAN 4							
36 OF 116	C-134	C-134-GP	GRADING AND DRAINAGE PLAN 5 GRADING AND DRAINAGE PLAN 6	87 OF 116 C-520	C-520-DT	PAVEMENT MARKING DETAILS 1				
37 01 110	0-100	0-100-01	GROUNG AND DISTINGE I DAY O			PAVEMENT MARKING DETAILS 2				CORRECT
38 OF 116	C-140	C-140-SPP	STORMWATER POLLUTION PREVENTION PLAN							OTHERWOODS
				89 OF 116 C-600	C-600GRD	UNDERDRAIN SCHEDULE				
39 OF 116	C-160	C-160-JP	JOINT LAYOUT PLAN 1	90 OF 116 P 4 004	U3568,-1001	LOCATION OF EXPLORATION 4F-02-1 THROUGH				
40 OF 116 41 OF 116	0-163 C-160A	C-164-JP C-160A-JP	JOINT ELEVATION PLAN JOINT LAYOUT PLAN 1			4F-02-24   FGEND AND NOTES		+		—— ⊢
42 OF 116	C-161A	C-161A-JP	JOINT LAYOUT PLAN 2	91 OF 116 B-3.002	U356B-3002	LOG OF EXPLORATIONS 4F-02-01 THROUGH 4F-02-9				
43 OF 116	C-162A C-163A	C-162A-JP C-164A-JP	JOINT LAYOUT PLAN 3 JOINT ELEVATION PLAN	92 UF 116 B-3.003 93 UF 116 B-3.004	U356B-3003	LOG OF EXPLORATIONS 4F-02-10 THROUGH 4F-02-18 LOG OF EXPLORATIONS 4F-02-19 THROUGH 4F-02-24		_		I
44 GI 110	0 C-100H	U TOTA U	CONTRACTOR POW							
							-			NAY.
45 OF 116	C-170	C-170-PMP	PAVEMENT MARKING PLAN 1 PAVEMENT MARKING PLAN 2				1			E. 1
46 OF 116	C-171	C-171-PMP	PAVEMENT MARKING PLAN 2				+			
							1			OND ONE
47 OF 116	C-210	C-210-CPR	RUNWAY 12R-30L PROFILE 1				+			Iš ,-
47 OF 116 48 OF 116		A 211 CDD	DINMAY 12D-301 DECELE 2				1			PROVINC
49 OF 116	C-212	C-212-CPR C-213-CPR	RUNWAY 12R-30L PROFILE 3 RUNWAY 12R-30L PROFILE 4				+			<b>  E</b>
SO OF ITE		0 2.0-01K	1 64 1 W W 64 1 1 1 W 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				1			
	_						-			SEAL SALEH OF
							1			
							-			S LORDAN P. TURNER E
	+	+				+	4			G No. DISTRE

# SECTION 02721A (Amended)

# SUBBASE COURSES 03/97

## PART 1 GENERAL

# 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1997) Moisture-Density Relations of Soils
	Using a 4.54-kg (10-lb) Rammer and an 457
	mm (18-in) Drop

# AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2487	(2000) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and

Soil-Aggregate in Place by Nuclear Methods

(Shallow Depth)

ASTM D 3017 (1988; R 1996el) Water Content of Soil and

Rock in Place by Nuclear Methods (Shallow

Depth)

ASTM D 4318 (2000) Liquid Limit, Plastic Limit, and

Plasticity Index of Soils

ASTM E 11 (1995) Wire-Cloth Sieves for Testing

Purposes

#### 1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; FIO

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sampling and Testing; FIO

Copies of initial and in-place test results.

## 1.3 UNIT PRICES

# 1.3.1 Measurement (Amended)

#### 1.3.1.1 Volume

The quantity of subbase course completed and accepted as determined by the Contracting Officer will be measured in cubic yards. The volume of material in-place and accepted will be determined by the average job thickness obtained in accordance with paragraph THICKNESS CONTROL and the dimensions shown.

## 1.3.1.2 Area

The quantity of separation layer completed and accepted as determined by the Contracting Officer will be measured in square yards.

# 1.3.2 Payment

#### 1.3.2.1 Course Material

Quantities of subbase course and separation layer, determined as specified in paragraph Measurement, will be paid for at the respective contract unit prices, which shall constitute full compensation for the construction and completion of the subbase course and separation layer.

#### 1.4 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 or AASHTO T 180, Method D. In this specification, degree of compaction shall be a percentage of laboratory maximum density.

#### 1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved testing laboratory in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Tests shall be performed at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements.

## 1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

#### 1.5.2 Tests

#### 1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136 and ASTM D 422. Sieves shall conform to ASTM E 11.

# 1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with  ${\tt ASTM}$  D 4318.

## 1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture shall be determined in accordance with ASTM D 1557 or AASHTO T 180, Method D.

## 1.5.2.4 Density Tests

Density shall be field measured in accordance with ASTM D 1556. ASTM D 2922 may be used. The calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with

ASTM D 2922 result in a wet unit weight of soil and, when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D 2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.

#### 1.5.2.5 Wear Test

Wear tests shall be made on subbase course material in conformance with  ${\tt ASTM}$  C 131.

## 1.5.3 Testing Frequency

## 1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation.

- a. Sieve Analysis including 0.02 mm size material
- b. Liquid limit and plasticity index moisture-density relationship
- c. Wear

### 1.5.3.2 In-Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted subbase course and separation layer. Samples shall be taken for each 1000 square yards of each layer of material placed in each area.

- a. Sieve Analysis including 0.02 mm size material
- b. Field Density
- c. Moisture liquid limit and plasticity index

# 1.5.4 Approval of Material

The source of the material shall be selected 28 days prior to the time the material will be required in the work. Approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted subbase course.

## 1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

## 1.7 EQUIPMENT

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

#### PART 2 PRODUCTS

#### 2.1 MATERIALS

#### 2.1.1 Subbase Course and Select Fill (Amended)

Aggregates shall consist of crushed stone , gravel, sand, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the No. 4 sieve shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested as specified in ASTM C 131. Aggregate shall be reasonably uniform in density and quality. Aggregates shall have a maximum size of 1 1/2 inch and shall be within the limits specified as follows:

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 3	
No. 10	50		
No. 200	15	15	

Particles having diameters less than 0.0008 inches shall not be in excess of 3 percent by weight of the total sample tested as determined in accordance with ASTM D 422. The portion of any blended component and of the completed course passing the No. 40 sieve shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. Subbase materials and select fill shall meet the requirements of Gradation No. 3.

## 2.1.2 Separation Layer

Materials shall meet the requirements in Paragraph 2.1.1, Gradation No. 1. Gradations for both the separation layer and the drainage layer must meet the requirements of the  $D_{15}$ ,  $d_{15}$ ,  $d_{85}$  ratios as shown below:

D=drainage layer d=separation layer

 $D_{15}/d_{85} \ge 3$  and  $D_{15}/d_{85} \le 5$ 

## PART 3 EXECUTION

#### 3.1 OPERATION OF AGGREGATE SOURCES

All clearing, stripping and excavating work involved in the opening or operation of aggregate sources shall be performed by the Contractor. Aggregate sources shall be opened to working depth in a manner that produces excavation faces that are as nearly vertical as practicable for the materials being excavated. Materials excavated from aggregate sources shall be obtained in successive cuts extending through all exposed strata. All pockets or strata of unsuitable materials overlying or occurring in the deposit shall be wasted as directed. The methods of operating aggregate sources and the processing and blending of the material may be changed or modified by the Contracting Officer, when necessary, in order to obtain material conforming to specified requirements. Upon completion of work, aggregate sources on Government reservations shall be conditioned to drain readily, and shall be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws and authorities.

#### 3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

## 3.3 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the subbase course and the separation layer, the underlying course or subgrade shall be cleaned of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Ruts, or soft yielding spots, in the underlying courses, subgrade areas having inadequate compaction, and deviations of the surface from the specified requirements, shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the subbase course. Stabilization shall be accomplished by mixing subbase-course material into the underlying course, and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements for the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the subbase course is placed.

### 3.4 GRADE CONTROL

The finished and completed subbase course shall conform to the lines,

grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the work site.

#### 3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the subbase or separation layer material at the water content specified. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

#### 3.6 LAYER THICKNESS

The compacted thickness of the completed course shall be as indicated. When a compacted layer of 6 inches is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

#### 3.7 COMPACTION

Each layer of the subbase courseand the separation layer shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 1 1/2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory subbase course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

# 3.8 PROOF ROLLING (Amended)

Proof rolling shall be performed from station 10+00 to station 80+00 on the layer immediately below the 6-inch seperation layer. Proof rolling shall be performed under the bituminous portions of the pavement sections and overlap at least 10 feet into the concrete pavement keel section. Proof rolling of the areas indicated shall be in addition to the compaction specified and shall consist of the application of 30 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 150 psi. Water content of the underlying material shall be maintained at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and

proof rolled to meet these specifications.

#### 3.9 EDGES

Approved material shall be placed along the edges of the subbase course and the separation layer in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1 foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the subbase course, as directed.

## 3.10 SMOOTHNESS TEST

The surface of each layer shall not show deviations in excess of 3/8 inch when tested with a 12 footstraightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting, as directed.

#### 3.11 THICKNESS CONTROL

The completed thickness of the subbase course and the separation layer shall be in accordance with the thickness and grade indicated on the drawings. The thickness of each course shall be measured at intervals providing at least one measurement for each 500 square yards or part thereof of subbase course and separation layer. The thickness measurement shall be made by test holes, at least 3 inches in diameter through the course. The completed subbase course and separation layer shall not be more than 1/2 inch deficient in thickness nor more than 1/2 inch above or below the established grade. Where any of these tolerances are exceeded, the Contractor shall correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 1/2 inch or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness shown.

#### 3.12 MAINTENANCE

The subbase course and the separation layer shall be maintained in a satisfactory condition until accepted.

-- End of Section --

# NOTE to Specification 02721A, Para 2.1.1:

- 1. In cut areas, remove 12 inches of material below the bottom of the subbase and replace with 12 inches of select fill.
- 2. In fill areas where the fill thickness below the subbase exceeds 12 inches, place a minimum of 12 inches of select fill in the upper portion of the fill material.
- 3. In fill areas where the fill thickness below the subbase is less than 12 inches, excavate and remove material to a depth to replace with at least 12 inches of select fill.

The compaction of the select fill and the placement lifts are specified on the drawings.

\*

USACE / NAVFAC / AFCESA

UFGS-16526A (August 2001)

Preparing Activity: USACE

Superseding UFGS-16526 (September 1992)

#### UNIFIED FACILITIES GUIDE SPECIFICATIONS

Latest change indicated by CHG tags

SECTION 16526A (Amended)

AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS 08/01

\*

NOTE: This guide specification covers the requirements for lighting and visual navigation aids for airfields and heliports.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

PART 1 GENERAL

\*

NOTE: If the existing facility is to be operational during construction, a scheduling plan properly coordinated with the airfield or heliport users should be developed and included as part of the bid package. Maximum outage time allowed should be specified for critical lighting, visual navigational aids and utility systems. Minimum advance notice (48 hrs, 72 hrs, etc.) for proposed outages should be specified. Consider transfer of control from the Control Tower to the alternate control point (vault) to maintain the mission for limited times during construction and to minimize mission disruption and potential cost growth during construction. If this is not possible, the scheduling can be delegated to the construction phase of the project by inserting the following text in Part 1.

"Existing {airfield} {heliport} [helipad] lighting systems shall remain in operating condition except for minimum interruptions, as approved in writing by the Contracting Officer. Prior to each interruption, all necessary materials and a sufficient labor force shall be assembled to permit completing the work within the scheduled time

interval. Under no circumstances shall any of the existing airfield or heliport lighting circuits be left inoperative without making provisions for suitable temporary connections in the affected area or areas. All airfield, heliport, or helipadlighting circuits covered under this contract shall be restored in such a manner that they will be operational at dusk each day. The Contractor shall submit a plan for outages and maintaining lighting and lighting control."

#### 1.1 REFERENCES

\*

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest change (Notice) to this guide specification.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C119.1 (1986; R 1997) Sealed Insulated

Underground Connector Systems Rated 600

Volts

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.12.13 (1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit

Installations, Including Unit Substations

ANSI C57.12.50 (1981; R 1989) Ventilated Dry-Type

Distribution Transformers 1 to 500 kVA,

Single-Phase; and 15 to 500 kVA,

Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts

ANSI C119.1 (1986; R 1997) Sealed Insulated

Underground Connector Systems Rated 600

Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M (2001) Zinc (Hot-Dip Galvanized) Coatings

on Iron and Steel Products

ASTM A 153/A 153M (2001) Zinc Coating (Hot-Dip) on Iron and

Steel Hardware

ASTM A 780	(2000) Repair of Damaged and Uncoated areas of Hot-Dipped Galvanized Coatings
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 709	(2000) Laminated Thermosetting Materials
ASTM D 1248	(2000) Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASSOCIATION OF EDISON I	LLUMINATING COMPANIES (AEIC)
AEIC CS5	(1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
FACTORY MUTUAL ENGINEER	ING AND RESEARCH (FM)
FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment
U.S. FEDERAL AVIATION A	DMINISTRATION (FAA)
FAA AC 70/7460-1	(Rev J) Obstruction Marking and Lighting
FAA AC 150/5345-3	(Rev E) L-821 Panels for (Rev E) Control of Airport Lighting
FAA AC 150/5345-5	(Rev A) Circuit Selector Switch
FAA AC 150/5345-7	(Rev D; Change 1) L-824 Underground Electrical Cable for Airport Lighting Circuits
FAA AC 150/5345-10	(Rev E) Constant Current Regulators Regulator Monitors
FAA AC 150/5345-12	(Rev C) Airport and Heliport Beacons
FAA AC 150/5345-13	(Rev A) L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
FAA AC 150/5345-26	(Rev B; Changes 1 & 2) L-823 Plug and Receptacle, Cable Connectors
FAA AC 150/5345-27	(Rev C) Wind Cone Assemblies
FAA AC 150/5345-28	(Rev D) Precision Approach Path Indicator (PAPI) Systems
FAA AC 150/5345-42	(Rev C; Change 1) Airport Light Bases,

	Transformer Houses, Junction Boxes and Accessories
FAA AC 150/5345-43	(Rev E) Obstruction Lighting Equipment
FAA AC 150/5345-44	(Rev F) Taxiway and Runway Signs
FAA AC 150/5345-45	(Rev A) Lightweight Approach Light Structure
FAA AC 150/5345-46	(Rev B) Runway and Taxiway Light Fixtures
FAA AC 150/5345-47	(Rev A) Isolation Transformers for Airport Lighting Systems
FAA AC 150/5345-49	(Rev A) Specification L-854, Radio Control Equipment
FAA AC 150/5345-51	(Basic; Change 1) Discharge-Type Flashing Light Equipment
FAA AC 150/5370-10	(Rev A; Changes 1 thru 11) Specifying Construction of Airports
FAA C-6046	(1978) Frangible Coupling Type I and Type 1A, Details
FAA E-982	(Rev H; Notice 1) PAR-56 Lampholder
FAA E-2159	(Rev D; Amend 1) Runway End Identifier Lighting System (REIL) with Remote Monitoring Subsystem
FAA E-2325	(Rev D) Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR)
FAA E-2628	(Rev B) Sequenced Flashing Lighting System, Elevated and Semiflush with Dimming and Monitoring
FAA E-2702	(1979) (REV A) Low Impact Resistant Structures
FAA E-2756	(1993) (REV A) Four-Box Precision Approach Path Indicator
INSTITUTE OF ELECTRICAL	AND ELECTRONICS ENGINEERS (IEEE)
IEEE C2	(1997) National Electrical Safety Code
IEEE C62.11	(1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 48 (1998) Standard Test Procedures and

Requirements for Alternating-Current Cable

Terminations 2.5 kV through 765 kV

#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA	250	(1997)	Enclosur	ces	for	Electrical	Equipment

(1000 Volts Maximum)

NEMA AB 1 (1993) Molded Case Circuit Breakers and

Molded Case Switches

NEMA ICS 2 (1993) Industrial Controls and Systems

Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC

or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems,

Enclosures

NEMA LA 1 (1992) Surge Arresters

NEMA PB 1 (1995) Panelboards

NEMA RN 1 (1998) Polyvinyl-Chloride (PVC) Externally

Coated Galvanized Rigid Steel Conduit and

Intermediate Metal Conduit

NEMA TC 2 (1998) Electrical Polyvinyl Chloride (PVC)

Tubing (EPT) and Conduit (EPC-40 and

EPC-80)

NEMA TC 3 (1990) PVC Fittings for Use with Rigid PVC

Conduit and Tubing

NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct

for Underground Installation

NEMA WC 3 (1992; Rev 1 1994) Rubber-Insulated Wire

and Cable for the Transmission and Distribution of Electrical Energy

NEMA WC 7 (1988; Rev 3 1996)

Cross-Linked-Thermosetting-Polyethylene-Insulated

Wire and Cable for the Transmission and

Distribution of Electrical Energy

NEMA WC 8 (1988; Rev 3 1996)

Ethylene-Propylene-Rubber-Insulated Wire

and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

REA Bulletin 1753F-205 (PE-39) (1993) Filled Telephone Cables

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (1991) Zinc-Rich Primers (Type I - "Inorganic" and Type II - "Organic")

# UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 6	(1997) Rigid Metal Conduit
UL 44	(1999) Thermoset-Insulated Wires and Cables
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL Elec Const Dir	(1999) Electrical Construction Equipment Directory

# 1.2 GENERAL REQUIREMENTS

Items of the same classification shall be identical including equipment, assemblies, parts, and components.

# 1.2.1 Code Compliance

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 and local codes where required.

#### 1.2.2 Standard Product

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

#### 1.2.3 Prevention of Corrosion

#### 1.2.3.1 Metallic Materials

Metallic materials shall be protected against corrosion as specified. Aluminum shall not be used in contact with earth or concrete. Aluminum conductors shall not be used.

#### 1.2.3.2 Ferrous Metal Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 123/A 123M and ASTM A 153/A 153M.

#### 1.2.3.3 Luminaires Fabricated from Ferrous Metals

Luminaires fabricated from ferrous metals, unless hot-dip galvanized or of porcelain enamel finish shall be factory finished with a weather-resistant finish in accordance with paragraphs FACTORY COATING and FINISHING, except exposure shall be 200 hours. Finish color shall be the manufacturer's standard, unless otherwise indicated.

#### 1.2.4 Unusual Service Conditions

Items furnished under this section shall be specifically suitable for the following unusual service conditions:

# 1.2.4.1 Altitude

Any equipment shall be suitable for operation up to an altitude of 10,000 feet.

#### 1.2.4.2 Other

Material or equipment to be installed underground; in handholes or in light bases, shall be suitable for submerged operation.

# 1.2.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### 1.3 SYSTEM DESCRIPTION

The airfield lighting and visual navigation aids shall consist of runway lights, taxiway lights, visual glide slope indicator, runway end identifier lights, runway distance markers, taxiway signs, and the lighting power

supply and control.

#### 1.4 SUBMITTALS (Amended)

\*

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

Indicate submittal classification in the blank space following the name of the item requiring the submittal by using "G" when the submittal requires Government approval. Submittals not classified as "G" will show on the submittal register as "Information Only". For submittals requiring Government approval, a code of up to three characters should be used following the "G" designation to indicate the approving authority; codes of "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval are recommended.

\*

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting and Navigation Aids; GA

Coordination drawings consisting of composite drawings showing coordination of work of one trade with that of other trades and with the structural and architectural elements of the work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between the various trades.

As-Built Drawings; GA

Drawings that provide current factual information including deviations from, and amendments to the drawings and changes in the work, concealed and visible, shall be provided as instructed. The as-built drawings shall show installations with respect to fixed installations not associated with the systems specified herein. Cable and wire shall be accurately identified as to direct-burial or in conduit and shall locate the connection and routing to and away from bases, housings, and boxes. The as-built information shall include surveyed locations of pre-placed light bases for future taxiway edge lights, as indicated on the drawings.

SD-03 Product Data

Materials and Equipment; GA

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each itemization shall include an item number, the quantity of items proposed, and the name of the manufacturer. Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

Training; FIO

Information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules of training, 6 weeks before training is scheduled to begin.

Parts; FIO

A list of parts and components for the system by manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delays.

SD-06 Test Reports

Field Quality Control; GA

Upon completion and testing of the installed system, performance test reports are required in booklet form showing all field tests performed to adjust each component and all field tests performed to provide compliance with the specified performance criteria. Each test shall indicate the final position of controls.

Field test reports shall be written, signed and provided as each circuit or installation item is completed. Field tests shall include resistance-to-ground and resistance between conductors, and continuity measurements for each circuit. For each series circuit the input voltage and output current of the constant current regulator at each intensity shall be measured. For multiple circuits the input and output voltage of the transformer for each intensity setting shall be measured. A visual inspection of the lights operation, or of the markings appearance, or of the installation of fixtures or units installed shall be reported.

Inspection; FIO

Inspection reports shall be prepared and provided as each stage of installation is completed. These reports shall identify the activity by contract number, location, quantity of material placed, and compliance with requirements.

SD-07 Certificates

Welding; FIO Cables, General Requirements; FIO

Certifications, when specified or required, including Certification of the Qualifications of Medium-Voltage Cable Installers, Certified Factory and Field Test Reports, and Certificates of Compliance submitted in lieu of other proofs of compliance with these contract provisions. A certification that contains the names and the qualifications of persons recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract shall be included. The certification shall indicate that any person recommended to perform actual splicing and termination has been adequately trained in the proper techniques and has had at least 3 recent years of experience in splicing and terminating the same or similar types of cables approved for installation. Any person recommended by the Contractor may be required to perform a dummy or practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types. The certification shall be prepared in conformance with paragraph CERTIFICATES OF COMPLIANCE in the SPECIAL CONTRACT REQUIREMENTS, and shall be accompanied by satisfactory proof of the training and experience of persons recommended by the Contractor as cable installers.

## Materials and Equipment; GA

When equipment or materials are specified to conform to the standards or publications and requirements of AASHTO, ANSI, ASTM, AEIC, FM, IEEE, IES, NEMA, NFPA, or UL, or to an FAA, FS, or MS, proof that the items furnished under this section of the specifications conform to the specified requirements shall be included. The label or listing in UL Elec Const Dir or in FM P7825a, FM P7825b or the manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance. Certificates shall be prepared by the manufacturer when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

#### SD-10 Operation and Maintenance Data

### Equipment; GA

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set shall be furnished prior to performance testing and the remainder shall be furnished upon acceptance. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include conduit and equipment layout and simplified wiring and control

diagrams of the system as installed.

#### 1.5 MEASUREMENT AND PAYMENT (Amended)

All work and incidentals assciated with this Section will be paid for by lump sum under item "Runway Lighting including PAPI."

#### PART 2 PRODUCTS

# 2.1 As-Built Drawings

Following project completion or turnover, within 30 days the Contractor shall furnish 3 sets of as-built drawings to the Contracting Officer.

### 2.2 Lighting and Navigation Aids

Coordination drawings consisting of composite drawings showing coordination of work of one trade with that of other trades and with the structural and architectural elements of the work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between the various trades.

#### 2.1 MATERIALS

Equipment and materials shall be new unless indicated or specified otherwise. Materials and equipment shall be labelled when approved by Underwriters Laboratories (UL) or Factory Mutual (FM) System. Askarel and insulating liquids containing polychlorinated biphenyls (PCB's) will not be allowed in any equipment. Equipment installed below grade in airfield lighting vault and handholes shall be the submersible type.

### 2.1.1 Electrical Tape

Electrical tape shall be UL 510 plastic insulating tape.

### 2.1.2 Nameplates

Each major component of equipment shall have as a minimum the manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment. Laminated plastic nameplates shall be provided for equipment, controls, and devices to identify function, and where applicable, position. Nameplates shall be 3.2 mm (1/8 in.) 1/8 inch thick laminated cellulose paper base phenolic resin plastic conforming to ASTM D 709 sheet type, grade ES-3, white with black center core. Surface shall be a matte finish with square corners. Lettering shall be engraved into the black core. Size of nameplates shall be 25.4 by 63.5 mm (1 by 2-1/2 in.)1 by 2-1/2 inches minimum with minimum 6.4 mm (1/4 in.)1/4 inch high normal block lettering. Nameplates provided as indicated. Nameplates shall be fastened to the device with a minimum of two sheet metal screws or two rivets.

### 2.1.3 Conduit, Conduit Fittings, and Boxes

# 2.1.3.1 Rigid Steel or Intermediate Metal Conduit (IMC) and Fittings

The metal conduit and fittings shall be UL 6 and UL 1242, respectively,

coated with a polyvinylchloride (PVC) sheath bonded to the galvanized exterior surface, nominal 1.0 mm (40 mils)40 mils thick, conforming to NEMA RN 1.

#### 2.1.3.2 Flexible Metal Conduit

UL 360 liquid-tight flexible metal conduit shall be used in all locations, including wet locations.

2.1.3.3 Outlet Boxes for Use with Steel Conduit, Rigid or Flexible

These outlet boxes shall be UL 514A, cast metal with gasket closures.

2.1.3.4 Plastic Duct for Concrete Encased Burial

These ducts shall be provided as specified in Section 16375A, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.1.3.5 Plastic Conduit for Direct Burial

This plastic conduit shall be provided as specified in Section 16375A, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.1.3.6 Frangible Couplings and Adapters

These frangible couplings shall be in accordance with FAA C-6046. Upper section of frangible coupling shall be provided with one of the following:

- a. Unthreaded for slip-fitter connections.
- b. 61.1 mm (2-13/32 in.)2-13/32 inch 16N-1A modified thread for nut and compression ring to secure 50 mm (2 in.)2 inch EMT.
- c. 50 mm (2 in.)2 inch 11-1/2-N.P.T. (tapered) with 5.6 mm (7/32 in.) 7/32 inch nominal wall thickness to accept rigid conduit coupling.
- d. Frangible Couplings for specialized applications as approved.
- e. Electrical Metallic Tubing UL 797, where indicated for use with frangible couplings and adapters.
- 2.1.3.7 Coilable Plastic Duct With Factory Installed Type L-824 Cable
  - a. In lieu of the direct buried plastic duct with type L-824 cables and groundwire, Contractor may provide coilable plastic duct with factory installed type L-824 cables with groundwire, as sized in the drawings, for the 1-way 2" duct not under pavement serving the interim runway and taxiway series circuits, including PAPI and signage. Coilable plastic duct assemblies to be plowable type.

### 2.1.4 Wire and Cable

Conductors shall be copper. Aluminum shall not be permitted.

2.1.4.1 Conductor Sizes

\*

NOTE: Refer to Article 310-5 of NFPA 70 for minimum conductor sizes. Require insulation thickness for 28 kV and 35 kV cables to be in accordance with AEIC specifications since NEMA specifications do not give an insulation thickness for the 133 percent level. When specifying 28 and 35 kV cables, add the requirements for not exceeding IEEE STD since this requirements is necessary as indicated by reference to the normal industry test values give in the table below.

### 15 MINUTE DRY WITHSTAND DC TEST VOLTAGES (kV)

Cable, Rates Voltage		ercent ation	Terminations	Joints on Extruded Dielectric Cable		
Phase	NEMA	AEIC				
to Phase	WC 7 WC 8	CS5 CS6	IEEE Std 48	IEEE STD 404		
2.5	25		40			
5.0	25		50	25		
8.7	35		65	35		
15	65		75	55		
25	100		105	75		
28		125	115	85		
34.5		155	140	100		
*****	*****	******	******	******		

Conductor size shall conform to American Wire Gage (AWG). Conductor sizes larger than No. 8 AWG shall be stranded. No. 8 AWG and smaller may be solid or stranded unless otherwise indicated.

### 2.1.4.2 Low Voltage Wire and Cable

UL 854, Type XHHW UL 44, shall be used for  $600\ V$  circuits installed in underground duct.

### 2.1.4.3 Power Cables for Use in Airfield and Heliport Lighting

Power cables shall be rated 5 kV, 133 percent insulation level, with shield and jacket conforming to NEMA WC 8 for ethylene-propylene rubber insulated cables.

2.1.4.4 Wire and Cable for Airfield and Heliport Lighting Systems

\*

NOTE: FAA AC 150/5345-7 covers Type A (rubber), Type B (ethylene-propylene), and Type C (crosslinked polyethylene) cable. Each type has 600 volt and 5000 volt ratings with single and multiple conductors. Type A and B have overall jackets while C only has the overall jacket for the multiple conductor cables. Type C is recommended for single conductor cable. If soil conditions require a jacketed cable for protection of insulation, specify Type B.

- a. Airfield and heliport lighting cable shall be FAA AC 150/5345-7, Type L-824 for crosslinked polyethylene Type C5000. Series airfield and heliport lighting cable shall be unshielded. Lighting cable for multiple type lighting circuits shall be unshielded.
- c. Counterpoise Wire. No. 4 AWG bare stranded copper, annealed or soft drawn.
- d. Control Cable. Cable shall be Type XHHW and as indicated on the drawings.
- e. Fused Cable Connectors. Connector shall consist of a line-side receptacle and a load-side plug, each in a molded rubber form and including crimp-on fittings for the cable ends to accommodate a 250-volt cartridge-type fuse with fuse rating as indicated. Connectors in kit form shall be properly sized for the specific cable diameter involved. Completed connection shall be watertight.

## 2.1.4.5 Cable Tags

Cable tags for each cable or wire shall be installed at duct entrances entering or leaving handholes, and at each terminal within the lighting vault. Cable tags shall be stainless steel, bronze, lead strap, or copper strip, approximately 1.6 mm (1/16 in.)1/16 inch thick or hard plastic 3.2 mm (1/8 in.)1/8 inch thick suitable for immersion in salt water and impervious to petroleum products and shall be of sufficient length for imprinting the legend on one line using raised letters. Cable tags shall be permanently marked or stamped with letters not less than 6.4 mm (1/4 in.) 1/4 inch in height as indicated. Two-color laminated plastic is acceptable. Plastic tags shall be dark colored with markings of light color to provide contrast so that identification can be easily read. Fastening material shall be of a type that will not deteriorate when exposed to water with a high saline content and to petroleum products.

#### 2.1.5 Ground Rods

Ground rods shall be sectional copper-clad steel with diameter adequate to permit driving to full length of the rod, but not less than 19.1 mm (3/4 in.)3/4 inch in diameter and not more than 3.048 meters (10 feet)10 feet long, unless indicated otherwise.

### 2.1.6 Lightning Arresters

These lightning arresters shall be in accordance with IEEE C62.11 and IEEE C62.41 as applicable with ratings as indicated.

### 2.1.7 Surge Protection

Surge protection shall be metal oxide varistors (MOV) in accordance with NEMA LA 1 for power and signal circuits with ratings as recommended by the system manufacturer.

### 2.1.8 Cable Connectors and Splices

For FAA Type L-824 lighting cable, connectors and splices shall be FAA AC 150/5345-26, Type L-823.

#### 2.1.9 Transformers

******	********************
	NOTE: Occasionally, power transformers will be
	needed to support airport or heliport systems.
	Prepare this paragraph as necessary to suit the
	specific airfield or heliport installation.

### 2.1.9.1 Encapsulated Isolation Transformers

These transformers shall be FAA AC 150/5345-47, Type L-830. Each transformer shall be provided with rating as shown on the contract drawings.

## 2.1.10 Light Bases

**************************	* *
NOTE: Use FAA AC 150/5345-42 Type L-867 bases for	
applications not subject to aircraft or vehicle	
loading. Use Type L-868 for applications subjected	
to aircraft or vehicle loading. Use Type L-869 as a	
junction box in all pavements.	

Light bases shall be FAA AC 150/5345-42 Type L-867 or L-868 as indicated. Steel bases, Class 1, Size B shall be provided as indicated or as required to accommodate the fixture or device installed thereon if diameter is not shown.

### 2.1.10.1 Accessories

Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures. Bolts shall be stainless steel.

### 2.1.11 Sealant for Fixtures and Wires in Drilled Holes or Saw Kerfs

The sealant shall be in accordance with FAA AC 150/5370-10, Type P-606. Use FAA AC 150/5370-10, Type P-606 sealant for use in asphaltic concrete (AC) or Portland cement concrete (PCC) pavement compatible with AC pavement and having a minimum elongation of 50 percent. Formulations of Type P-606 which are compatible with PCC pavement only are prohibited.

### 2.1.12 Constant Current Regulator

The regulator shall be FAA AC 150/5345-10, Type L-829 with monitoring system and with ratings as indicated, ferro-resonant type. Regulators  $30\,\mathrm{km}$ 

and above shall be oil filled type. Regulators below 30kw shall be dry type.

# 2.1.12.1 Regulator Options

Regulators shall operate on 60 Hz, have internal primary switch included, have input voltage of 480 and be controlled by 120-volt internal control voltage. Three or five brightness steps as indicated shall be provided. Monitors shall be provided as indicated. Provide built-in true rms ammeter, overcurrent and open circuit protection, output lightning and transient protection, and display of load voltage and volt-amperes on the load side.

#### 2.1.12.2 S-1 Cutout

Provide S-1 plug cutout, in NEMA 1 enclosure with door and handle, for the output side of the regulator.

### 2.1.13 Lamps and Filters

Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors as indicated and conforming to the specification for the light concerned or to the standard referenced.

#### 2.1.20 Control Panel

*****	*****	*****	***	****	***	******	***	*****	******	*
	NOTE:	Refer	to	FAA	AC	150/5345-3	for	type,	class,	
	and st	yle.								
******	******	*****	***	****	***	********	****	*****	*******	*

The existing panel shall be modified as indicated on the drawings.

### 2.1.21 Radio Control

Provide radio control unit complying with FAA AC 150-5345-49. The radio control shall operate with 120 Vac +/-15%, 60 Hz input power. Equipment to be provided with radio controller: lightning arrestors, antenna kit and mounting hardware, interface panel, RL-854 radio control unit, and instruction manual. Antenna kit shall as a minimum include antenna with mounting hardware, and coaxial cable of sufficient length for the antenna to be mounted on the airfield lighting vault.

The radio control equipment shall operate the lighting systems indicated, and shall operate at the same frequency as the existing radio control serving existing airfield lighting.

### 2.1.21 Lighting Fixtures

visual aids operational should be specified in the drawings or other specification requirements. Select only items applicable to the installation of

the contract.

See Army Standard Detail No. 40-06-05 for the lighting fixtures for specific airfield and heliport lighting applications.

The lighting fixtures for the airfield and heliport lighting shall be as shown in the contract drawings or as required in other contract documents.

#### 2.1.22 Painting

As specified in Section 02763A, PAVEMENT MARKINGS.

### 2.2 AIRFIELD AND HELIPORT MARKINGS

The airfield and heliport markings shall be installed as shown on the contract drawings.

#### 2.11 RUNWAY LIGHTING SYSTEM

Runway lights include runway edge lights, runway threshold/end lights, runway distance markers, mounting structures, controls, and the associated equipment and interconnecting wiring to provide complete systems as indicated and specified herein.

### 2.11.1 Runway Edge Lights

The runway edge light fixtures shall meet the requirements of FAA AC 150/5345-46, Type L-862, elevated high-intensity, lights. Lights shall have quartz-type lamp, with lens color as indicated. This includes edge lights through the overrun areas. Color aiming directions shall be as indicated.

# 2.11.2 Runway Threshold and End Lights

The threshold lights shall use aviation green filter and the end lights shall use aviation red filters. These lights may be combined in a single bidirectional fixture with the appropriate color filters if indicated on the contract drawings. The runway threshold and end light fixtures shall meet the requirements of FAA AC 150/5345-46, Type L-862E, elevated high-intensity, quartz lamp, unidiredctional or bidirectional airfield lights as indicated on the contract drawings.

### 2.11.3 Overrun Edge Lights

The overrun edge light fixtures shall meet the requirements of FAA AC 150/5345-46, Type L-862, elevated high-intensity, lights. Overrun edge ights shall be bi-directional, quartz-type lamp red-white. This includes edge lights through the overrun areas. Color aiming directions shall be as

indicated.

### 2.11.4 Runway Distance Markers

Runway distance markers shall conform to FAA AC 150/5345-44, Type L-858B, Size 4, Style 3 with white or yellow numerals on a black background. Markers shall be provided, to withstand a static wind load of 1.9 kPa (0.28 lb/sq in),0.28 pound per square inch, suitable for connection to the secondary of the isolation transformers specified, and shall have a power factor greater than or equal to 0.90. Internally illuminated markers shall be provided with illumination of the face not less than 50 percent of that at rated current when the series lighting circuit is operated at the lowest brightness step. Marker housing shall be fiber reinforced epoxy, with information faces of high-impact acrylic or ultraviolet stabilized polycarbonate. The power supply and lamps shall be Style 3, Class 1.

#### 2.12 TAXIWAY LIGHTING SYSTEMS

Taxiway lighting systems shall include edge lights, and guidance signs. These systems shall also include the associated equipment, power supplies and controls, mounting devices, and interconnecting wiring to provide complete systems as specified.

# 2.12.1 Taxiway Edge Lights

Taxiway edge light shall emit aviation blue light provided by filters or globes for both airfields and heliports. The edge lights shall meet the requirements of FAA AC 150/5345-46, Type L-861T, incandescent lamp, elevated lights.

### 2.12.3 Taxiway Guidance Signs

The taxiway guidance signs shall meet the requirements of FAA AC 150/5345-44, Type L-858Y for information, Type L-958L for location, and Type L-858R for mandatory signs. The size and information on the signs shall be as shown on contract drawings. The power supply to connect to series circuits shall be as indicated on the contract drawings.

#### 2.15 GLIDE SLOPE INDICATOR

The glide slope indicator for airfields shall be the Precision Approach Slope Indicator (PAPI).

# 2.15.1 PAPI

The light units for the PAPI shall meet the requirements of FAA AC 150/5345-28, Type L-880. The system consists of four light units. The PAPI shall have 3 lamps per light unit. The PAPI shall be Style B Class I.

#### 2.19 FACTORY COATINGS

\*

NOTE: A 200-hour test should be specified in a noncorrosive environment and a 500-hour test will be specified in a corrosive environment.

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finish shall be provided with corrosion-resistant finishes which shall withstand 200 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 in.)1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (Procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with zinc rich paint conforming to SSPC Paint 20 in accordance with ASTM A 780.

#### PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Circuits installed underground shall conform to the requirements of Section 16375A, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, except as required herein or indicated on the drawings. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415A ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316A EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall conform to the requirements of Section 03307ACAST-IN-PLACE STRUCTURAL ONCRETE.

# 3.2 CABLES, GENERAL REQUIREMENTS

The type of installation, size and number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Loads shall be divided as evenly as practicable on the various phases of the system.

Manufacturer's written recommendations shall be furnished for each type of splice and medium-voltage cable joint and termination, and for fireproofing application methods, and shall be approved before any work is done.

Medium-voltage cable joints and terminations shall be the standard product of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Medium-voltage cable joints shall be made by qualified cable splicers. Compounds and tapes shall be electrical grade suitable for the cable insulation provided and shall use design materials and techniques recommended by the manufacturer. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations.

# 3.2.1 Duct Line Installation

Cables shall be installed in duct lines. Cable splices shall be made in manholes and handholes only, except as otherwise noted. Neutral and ground conductors shall be installed in the same duct with their associated phase conductors. Counterpoise cable shall be installed in a separate duct or direct-burial not less than [150] [\_\_\_\_] mm6 inches above the uppermost duct containing electrical cable. Electrical metallic tubing shall not be

installed underground or enclosed in concrete.

#### 3.2.3 Connection to Buildings

Cables shall be extended into airfield lighting vault as indicated, and shall be properly connected to the first applicable termination point on the equipment in the vault.

#### 3.3 MEDIUM-VOLTAGE CABLES

Medium-voltage cables shall be suitable for a rated circuit voltage of 5 kV. Other parts of the cable system such as joints and terminations shall have ratings not less than the rating of the cables on which they are installed. Separable insulated connectors shall have nominal voltage ratings coordinated to associated apparatus ratings rather than cable ratings when used to connect cable to apparatus. Cables shall be provided with 133 percent insulation level. Neutral conductors of grounded neutral systems shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable.

#### 3.3.1 Cable Joints

Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint.

#### 3.3.1.1 Types

Separable insulated connectors of suitable construction or standard splice kits shall be used for single-conductor and two-conductor cables. The connectors shall be of FAA AC 150/5345-26 L-823 type.

### 3.3.1.2 Requirements

Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Lead sleeves shall be provided for lead-covered cables. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

### 3.3.2 Terminations

Terminations shall be IEEE Std 48, Class 1 or Class 2, of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

### 3.3.2.1 Factory Preformed Type

\*

NOTE: In areas where heavy fog, salt air, or medium to heavy industrial contamination occur, require that terminations pass the next higher wet withstand test for factory preformed terminations. For taped termination, use 318 mm (12-1/2 inches) for cable rated 5 kV, 508 mm (20 inches) for cable rated 15 kV, 635 mm (25 inches) for cable rated 25 kV, and 889 mm (35 inches) for cable rated 28 kV or 35 kV in normal atmospheres. Use next higher voltage level lengths in contaminated atmospheres which will require 1.2 meters (46 inches) for 28 kV or 35 kV cables.

\*

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall pass the wet withstand voltage test required by IEEE Std 48 for the next higher BIL level.

#### 3.4 LOW-VOLTAGE CABLES

Cable shall be rated 600 volts, except that secondaries of isolation transformer to in-pavement lights installed in pavement saw kerf and 48 volt DC control cables may be 300 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in wires No. 8 AWG single conductor cable shall be made with FAA AC 150/5345-26 Type L-823 connectors andnoninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

### 3.5 DUCT LINES

provided with the type of wall thickness that is in accordance with the appropriate communication agency's policy. Electrical metallic tubing will not be installed underground or encased in concrete.

\*

Duct lines shall be concrete-encased, thin-wall type, except as otherwise indicated on the contract drawings.

### 3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm 4 inches per 30 meters. 100 feet. Depending on the contour of the finished grade, the high point may be at a terminal,

a manhole, a handhold, or between manholes or handholes. Manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 in.) 18 inches for ducts of less than 78 mm (3 in.) 3 inches diameter, and 900 mm (36 in.) 36 inches for ducts 78 mm (3 in.) 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 meters (25 ft.) 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends as required, but the maximum curve shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes. Duct line markers shall be provided as indicated at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 0.127 mm (5 mil) 5 mil brightly colored plastic tape not less than 76.2 mm 3 inches in width and suitably inscribed at not more than 3.0 meters 10 feet on centers with a continuous metallic backing and a corrosion-resistant 0.025 mm (1 mil) 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm 12 inches below finished grade levels of such lines.

#### 3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 300 mm 12 inches long and shall have diameters 6.2 mm (1/4 in.) 1/4 inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

### 3.5.3 Concrete Encasement

Each single duct shall be completely encased in concrete with a minimum of 75 mm 3 inches of concrete around each duct, except that only 50 mm 2 inches of concrete are required between adjacent electric power or adjacent communication ducts, and 100 mm 4 inches of concrete shall be provided between adjacent electric power and communication ducts. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad crossings, tops of concrete encasements shall be not less than 450 mm 18 inches below finished grade or paving. At railroad crossings, duct lines shall be encased with concrete, reinforced as indicated. Tops of concrete encasements shall be not less than 1.5 meters 5 feet below tops of rails, unless otherwise indicated. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not further apart than 1.2 meters 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 150 mm 6 inches vertically.

### 3.5.4 Non-encased Direct-Burial

Top of duct lines shall be below frost line but not less than 600 mm24 inches below finished grade. Ducts shall be buried below frost line but in the earth and shall be installed with a minimum of 77 mm 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 300 mm 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand or stone-free earth, 75 mm 3 inch layers of sand or stone-free earth shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts in direct-contact tiered fashion. Joints in adjacent tiers of duct shall be vertically staggered at least 150 mm.6 inches. The first 100 mm 4 inch layer of backfill cover shall be sand or stone-free earth compacted as previously specified. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling. Selected earth at duct banks shall be thoroughly tamped in 100 to 150 mm 4 to 6 inch layers.

### 3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved. In the absence of specific recommendations, various types of duct joint couplings shall be made watertight as specified.

#### 3.5.5.1 Asbestos-Cement and Bituminized-Fiber Ducts

To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below minus 18 degrees C (0 degrees F). O degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 0 degrees C (32 degrees F). 32 degrees F.

### 3.5.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick one-quarter-turn twist to set the joint tightly.

### 3.6 HANDHOLES

\*

NOTE: When preparing Section 16375, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND for a project specification, the designer will edit the guide specification as necessary to suit the specific airfield or heliport installation. Note that airfield type manholes, vaults, handholes, and their associated frames and covers require a design for a maximum single wheel load of 22,680 kg (50,000 pounds) or dual wheel load of 40,820 kg (90,000 pounds). Use steel conforming to ASTM A36/A36M, for

covers to airfield manholes, vaults, and handholes. Use ductile iron for frames conforming to ASTM A 536, grade 65-45-12.

\*

The handholes shall be as specified in Section 16375AELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

#### 3.7 WELDING

The welding of supports and metallic ducts and welding or brazing of electrical connections shall be formed by qualified welders.

#### 3.8 CABLE MARKERS

Cable markers or tags shall be provided for each cable at duct entrances entering or leaving manholes or handholes and at each termination within the lighting vault. Cables in each manhole or handhole shall have not less than two tags per cable, one near each duct entrance hole. Immediately after cable installation, tags shall be permanently attached to cables and wires so that they cannot be accidentally detached.

### 3.9 FRANGIBLE REQUIREMENTS

Frangible supports, couplings, and adapters shall be installed as indicated or specified.

#### 3.10 ELEVATED AIRFIELD AND HELIPORT LIGHTS

Elevated lights shall be frangibly mounted, not to exceed 350 mm 14 inches in height except where higher mounting is permitted in snow accumulationareas. Equipment exceeding 350 mm14 inches in height shall be frangibly mounted as indicated.

### 3.11 SEMIFLUSH AIRFIELD AND HELIPORT LIGHTS

Water, debris, and other foreign substances shall be removed prior to installing semiflush light base and light. Positioning jigs shall be used to hold the light bases and/or lights to ensure correct orientation and leveling until the concrete, adhesive, or sealant can provide permanent support.

#### 3.13 SPLICES FOR AIRFIELD AND HELIPORT LIGHTING CABLE

# 3.13.1 Connectors

Kit type connectors shall be used to splice 5 kV single-conductor series lighting cables. During installation and prior to covering with earth, mating surfaces of connectors shall be covered until connected and clean when plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

# 3.13.2 Splicing Fixtures to the Wires in Pavement Saw Kerfs

Splices shall have preinsulated watertight connector sleeves crimped with a

tool that requires a complete crimp before tool can be removed. Splice shall be taped with plastic insulating tape.

#### 3.14 GROUNDING SYSTEMS

\*

NOTE: The preferred method of grounding is to have grounding circuits separate and not connected to the counterpoise. The light fixtures, equipment and buildings are connected to the grounding circuit. If necessary, grounding to the counterpoise may be permitted. In areas with low thunderstorm frequency and good ground conductance, the counterpoise ground rods may be spaced up to 600 meters (2000 feet) apart but other areas may require grounding at less than 300 meters (1000 feet) separation.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 3.14.1 Counterpoise Installation

Counterpoise wire shall be laid for entire length of circuits supplying airfield lighting, or as otherwise indicated on the drawings. Wire shall be in one piece, except where distance exceeds the length usually supplied. Counterpoise shall be installed on top of the envelope of concrete-encased duct and approximately 150 mm6 inches above direct burial cables and duct lines. Route the counterpoise around each light base or unit, at a distance of about 2 feet from the unit; do not connect the counterpoise to the unit. Where trenches or duct lines intersect, counterpoise wires shall be electrically interconnected by exothermic welding or brazing. Counterpoise to earth ground shall be connected at least every [600] [\_\_\_\_] meters 1,000 feet of cable run, and at lighting vault, by means of ground rods as specified. Do not connect counterpoise to the vault power grounding system. Counterpoise shall be installed in a separate duct under roads, railroads, and paved areas above the highest duct containing electrical or communications circuits.

### 3.14.2 Fixture Grounding

Each fixture or group of adjacent fixtures shall be grounded by a grounding circuit separate from the counterpoise system. Fixtures, steel light bases or grounding bushings on steel conduits shall be connected to an independent ground rod by a No. 6 AWG bare stranded copper wire. Semiflush fixtures for direct mounting in pavement need not be grounded. Copper wire shall be connected to ground rods by exothermic weld or brazing.

### 3.19 ISOLATION TRANSFORMERS

Transformer lead connections shall conform to FAA AC 150/5345-26. Transformer secondary connectors shall plug directly into a mating connector on the transformer secondary leads. During installation, mating surfaces of connectors shall be covered until connected and clean when plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant or with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

#### 3.20 RUNWAY AND TAXIWAY LIGHTING SYSTEMS

#### 3.20.1 Runway and Taxiway Edge Lights

Edge lights shall be elevated type lights except in paved areas where semiflush lights are required. Threshold and runway end lights shall be elevated type as indicated on the contract drawings. Elevated lights shall be frangibly mounted and each light supplied power through an isolation transformer. The taxiway lights shall be omnidirectional and only require leveling. The runway lights require leveling and alignment of the beams for the correct toe-in of the beams.

### 3.22 FIELD QUALITY CONTROL

The Contracting Officer shall be notified five working days prior to each test. Deficiencies found shall be corrected and tests repeated.

### 3.22.1 Operating Test

Each completed circuit installation shall be tested for operation. Equipment shall be demonstrated to operate in accordance with the requirements of this Section. One day and one night test shall be conducted for the Contracting Officer.

# 3.22.2 Distribution Conductors, 600-Volt Class

Test shall verify that no short circuits or accidental grounds exist using an instrument which applies a voltage of approximately 500 volts providing a direct reading in resistance.

### 3.22.3 Counterpoise System Test and Inspection

Continuity of counterpoise system shall be visually inspected at accessible locations. Continuity of counterpoise system to the vault grounding system shall be tested in manhole or handhole closest to the vault.

### 3.22.4 Progress Testing for Series Lighting Circuits

A megger test shall be conducted on each section of circuit or progressive combinations of sections as they are installed. Each section or progressive combination of sections shall be tested with a megohmmeter providing a voltage of approximately 1000 volts, a direct reading in resistance. Results shall be documented. Faults indicated by these tests shall be eliminated before proceeding with the circuit installation.

### 3.22.5 Electrical Acceptance Tests

Acceptance tests shall be performed for series and multiple airfield and heliport lighting circuits only on complete lighting circuits. Each series and multiple lighting circuit shall receive a high voltage insulation test.

#### 3.22.5.1 Low-Voltage Continuity Tests

Each series circuit shall be tested for electrical continuity. Faults indicated by this test shall be eliminated before proceeding with the high-voltage insulation resistance test.

### 3.22.5.2 High-Voltage Insulation Resistance Tests

Each series lighting circuit shall be subjected to a high-voltage insulation resistance test by measurement of the insulation leakage current with a suitable high-voltage test instrument which has a steady, filtered direct current output voltage and limited current. High-voltage tester shall include an accurate voltmeter and microammeter for reading voltage applied to the circuit and resultant insulation leakage current. Voltages shall not exceed test values specified below.

a. Test Procedure: Both leads shall be disconnected from regulator output terminals and support so that air gaps of several inches exist between bare conductors and ground. Cable sheaths shall be cleaned and dried for a distance of 300 mml foot from ends of cables and exposed insulation at ends of cables. Ends of both conductors of the circuit shall be connected together and to high-voltage terminals of test equipment, and test voltage applied as specified in the following tabulation between conductors and ground for a period of 5 minutes.

Test Voltage, dc

Series Lighting Circuits	First Test on New Circuits	Test on Existing Circuits
High Intensity Series Lighting Circuits (5,000 volt leads, 500 and 200 watt transformers)	9000	5000
Medium Intensity Series Lighting Circuits (5,000 volt leads, 30/45 watt transformers)	6000	3000
600-Volt Circuits	1800	600

When additions are made to existing circuits, only new sections shall be tested in accordance with "First Test on New Circuits" in table above. To ensure reliable operation, complete circuit shall be tested at reduced voltages indicated above.

b. Leakage Current: Insulation leakage current shall be measured and recorded for each circuit after a 1 minute application of the test voltage. If leakage current exceeds values specified below, the circuit shall be sectionalized and retested and the defective parts shall be repaired or replaced. Leakage current limits include allowances for the normal number of connectors and splices for each circuit as follows:

- (1) Three microamperes for each 300 meters1000 feet of cable.
- (2) Two microamperes for each 200 watt and each 500 watt 5,000-volt series transformer.
- (3) Two microamperes for each 30/45-Watt 5,000 volt series transformer.

If measured value of insulation leakage current exceeds calculated value, the circuit shall be sectionalized and tested as specified for each section. Defective components shall be repaired or replaced until repeated tests indicate an acceptable value of leakage current for the entire circuit.

# 3.22.6 Constant Current Regulators

Each constant current regulator shall be examined to ensure that porcelain bushings are not cracked, no shipping damage has occurred, internal and external connections are correct, switches and relays operate freely and are not tied or blocked, fuses, if required, are correct, and liquid level of liquid-filled regulators is correct. Relay panel covers shall be removed only for this examination; it is not necessary to open the main tank of liquid-filled regulators. The instructions on the plates attached to the regulators shall be followed. Covers shall be replaced tightly after completing examinations and tests.

#### 3.22.7 Regulator Electrical Tests

Supply voltage and input tap shall correspond. With the loads disconnected, regulator shall be energized and the open circuit protector observed to ensure that it de-energizes the regulator within 3 seconds. After testing circuits for open circuit and ground fault and corrections, if any, and after determining that lamps are serviceable and in place, the loads shall be connected for each circuit or combination of circuits to be energized by the regulator and the voltage and current measured simultaneously for each brightness tap. Voltmeter and ammeter shall have an accuracy of plus or minus 1 percent of meter full scale. Readings shall be recorded during the day and night in order to obtain the average supply voltage. Output current on each brightness tap shall be within plus or minus 2 percent full scale of the nameplate values after making necessary correction in the supply voltage. Late model regulators have automatic supply voltage correction in lieu of input taps, and output current does not change as supply voltage varies. When output current on highest intensity setting deviates from nameplate value by more than 2 percent of meter full scale and the regulator is not overloaded, internal adjustment shall be checked as described on regulator instruction plate. Since adjustment may be rather delicate, a deviation of up to plus or minus 5 percent of meter full scale is allowed for lower intensity settings before attempting to readjust the regulator.

# 3.22.8 Final Operating Tests

After completion of installations and the above tests, circuits, control equipment, and lights covered by the contract shall be demonstrated to be in acceptable operating condition. Each switch in the airfield lightingcontrol panel and radio control shall be operated so that each

switch position is engaged at least twice. During this process, lights and associated equipment shall be observed to determine that each switch properly controls the corresponding circuit. Telephone or radio communication shall be provided between the operator and the observer. Tests shall be repeated from the remote control points, and again from the local control switches on the regulators. Each lighting circuit shall be tested by operating the lamps at maximum brightness for not less than 30 minutes. At the beginning and at the end of this test the correct number of lights shall be observed to be burning at full brightness. One day and one night operating test shall be conducted for the Contracting Officer.

### 3.23 FINISHING

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as required in Section 0900 PAINTING, GENERAL.

-- End of Section --